METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS INFECTIONS (MRSA)

Abstract

Methicillin-resistant staphylococcus aureus infection is one of the most common sources of infections that occur in patients following hospitalization. The infection typically results from poor infection control and MRSA bacterium spreads between patients and healthcare staff. Methicillin resistant staphylococcus aureus infection can be prevented through the consistent use of Standard Precautions such as handwashing, the use of protective gloves, gowns, as well as proper handling and disposal of body fluids. All members of the health team are required to be educated on the transmission and prevention of methicillin resistant staphylococcus aureus to reduce the chance of spread of this pathogen.

Learning Objectives

1. Identify the correct definition of normal flora.
2. Identify two reasons why Staphylococcus aureus is dangerous.
3. Identify the basic causes of hospital-acquired MRSA infections.
4. Name three common types of MRSA infection.

Introduction

Methicillin-resistant *Staphylococcus aureus* is a strain of bacterium that is resistant to many of the commonly used antibiotics such as penicillin and the cephalosporins. Methicillin-resistant *Staphylococcus aureus* (MRSA) has attracted a lot of attention in the media, and the popular press has named MRSA the "superbug" and the "flesh-eating bacteria," identifying MRSA as a bacterium that can cause a frightening and dangerous condition called necrotizing fasciitis. The term superbug is somewhat sensational and although MRSA *can* cause necrotizing fasciitis, this is a rare condition and it can be caused by many bacterium, not just MRSA. MRSA however is a dangerous microorganism and is a pathogen that is carried by a large percentage of the population. It can cause infections essentially anywhere in the body, and MRSA infections can be difficult to treat. Hospital-acquired MRSA infections are probably impossible to prevent but the evidence is clear that many, if not most, MRSA infections that happen to inpatients can be prevented if members of the health team follow Standard Precautions such as handwashing, use of protective gloves, gowns, masks (if indicated) and the proper handling and disposal of body fluids. Because MRSA and MRSA infections are so common, Certified Nursing Assistants (CNAs) must understand what MRSA is, how it is transmitted, and how they can help prevent the spread of this dangerous pathogen.

MRSA and the Staphylococcus Aureus Bacterium

Methicillin-resistant *Staphylococcus aureus* is especially serious because MRSA is one of the most common sources of infections that occur in patients after they are admitted to a hospital. These infections are called hospital-acquired MRSA infections and many of these

infections happen because of poor infection control. The MRSA bacterium is spread from patients to healthcare staff and then to other patients. The term bacterium refers to a single microorganism, and bacteria is the plural term. Most people use the term bacteria to refer to both single and multiple microorganisms but that is not correct and bacterium and bacteria will be used here.

When people think of microorganisms such as bacteria and viruses they usually think of them as foreign "invaders" that cause illnesses, and to some extent that is certainly true. Microorganisms such as bacteria, fungi, and viruses can and do cause diseases and make people sick. A microorganism that can cause disease is called a pathogen, however many microorganisms and many pathogens are often not foreign. Everyone carries microorganisms, millions and millions of them, living in the stomach, in the nose and mouth, in the bowels, and on the skin. These microorganisms are called the *normal flora* of the human body and *Staphylococcus aureus* is part of normal flora. The term flora is defined as the plant life that naturally occurs in a specified area - in this case, the human body.

Approximately 25-50% of the population has *Staphylococcus aureus* living inside the nose, in the armpits, in the perineal area, and in the oropharynx. People who have insulin-dependent diabetes, who are infected with human immunodeficiency virus (HIV), and who need hemodialysis on a chronic basis are more likely to have *Staphylococcus aureus* in the nose and oropharynx or on the skin. Most of the time the *Staphylococcus aureus* bacterium does not cause illness or disease; many people have *Staphylococcus aureus* in or on their skin and in

other areas of the body and they do not develop a *Staphylococcus aureus* infection and become sick.

Staphylococcus aureus is a dangerous pathogen for several reasons. Firstly, *Staphylococcus aureus* can easily avoid the immune system and cause an infection, and it does so by several different mechanisms: The *Staphylococcus aureus* bacterium has strong enzymes that can break down tissues and allow the infection to spread; the bacterium also produces a protein that "disguises" *Staphylococcus aureus* from antibodies that would normally detect and destroy it; the *Staphylococcus aureus* bacterium can survive for weeks and months outside the body on medical equipment and other surfaces in the environment. When the environment is contaminated with MRSA it becomes easy for MRSA to be picked up by one person and transmitted to another.

Secondly, *Staphylococcus aureus* has mutated to a bacterium that cannot be treated by many of the commonly used antibiotics, the MRSA bacterium. Bacteria that can be treated with penicillins, cephalosporins, and other commonly used antibiotics have a molecule on their cell walls called the penicillin-binding protein. This protein allows the antibiotic to attach the bacteria and destroy it, but MRSA does not have the penicillin-binding protein so many antibiotics, especially the penicillins, are ineffective for treating an infection with MRSA. The mutation of *Staphylococcus aureus* into MRSA happens for a variety of complex reasons such as the overprescribing of antibiotics and by the natural ability of pathogens like *Staphylococcus aureus* to mutate in order to evade the body's immune system and survive.

An infection with MRSA cannot be treated with the following antibiotics. The generic names are listed first and the trade names are in parentheses.

- **Aminoglycosides - gentamicin (Garamycin), streptomycin**
- **Cephalosporins - cephalexin (Keflex), cefoxitin (Mefoxin)**
- **Fluoroquinolones - ciprofloxacin (Cipro), levofloxacin (Levaquin)**
- **Lincosamides - clindamycin (Cleocin), lincomycin (Lincocin)**
- **Macrolides - azithromycin (Zithromax), clarithromycin (Biaxin)**
- **Penicillins - penicillin G, ampicillin, amoxicillin, nafcillin**

Methicillin is not included in the above table of antibiotics; it is an old antibiotic that was developed in the 1950s to treat penicillin-resistant infections. Methicillin is no longer manufactured because other antibiotics are more stable and more effective, but the term methicillin-resistant *Staphylococcus aureus* is still used.
Fortunately, the MRSA bacterium is not as common as *Staphylococcus aureus* and approximately 1% to 16% of the population has MRSA somewhere on the skin. However, although MRSA may not be as common as *Staphylococcus aureus,* infections with MRSA can be very serious. This is not because the MRSA bacterium is always more powerful than strains of *Staphylococcus aureus* although it can be. The biggest reason infections with MRSA are such a problem is that they cannot be easily treated with antibiotics.

MRSA Spread of Infection

Methicillin-resistant *Staphylococcus aureus* is primarily spread by *skin contact* and by the *respiratory route*. MRSA can also be transmitted by infected blood. Transmission of MRSA by skin contact occurs commonly in healthcare facilities and in the community. Transmission of MRSA by the respiratory route is relatively common in healthcare facilities, but not as common in the community.

Infections with MRSA that happen in a healthcare facility are called hospital-acquired infections. Infections with MRSA that happen to people in the community are called community-acquired. For the most part, but not always, hospital-acquired and community acquired MRSA are different strains of the bacterium.

Hospital-Acquired MRSA Infections

Infections with MRSA that occur in the healthcare setting occur when the MRSA bacteria are spread from an infected patient to an uninfected patient by healthcare personnel. The MRSA bacteria can then gain access to tissues or the bloodstream of the uninfected patient by a break in the skin.

The MRSA bacterium can also be spread from patient to patient by infected respiratory droplets. These infections are common in the healthcare setting for the following reasons.

Patients are at Risk:

Many patients have chronic medical conditions that make them susceptible to developing infections. Also, as mentioned previously,

many surgical incisions and indwelling intravenous (IV) catheters and other medical devices provide an entry point for the MRSA bacteria to enter the body. Healthcare staff should remember that an intact skin is the body's first line of defense against infection.

Patient Contact is a Constant:

Most CNAs have regular physical contact with patients they are caring for, and the amount of physical contact with patients will differ, depending on where the CNA works. The physical contact can be a lot and generally continuous. In an average eight hour shift the CNA will take blood pressures, help people get dressed, perform catheter care, and at the end of a typical work day this contact will all add up to many instances of close physical contact with potentially infected patients.

MRSA is Easily Transmitted:

Methicillin-resistant *Staphylococcus aureus* is very easily transmitted from patients to healthcare personnel and then to other patients, and this can happen even in situations that may seem to be safe. Every time a healthcare worker makes physical contact with a patient there is a risk that MRSA (and other pathogens) can contaminate the gloves being worn, clothing, or skin, and if that happens the healthcare worker can transmit MRSA to another patient. One study tested the disposable gloves that nurses wore when performing patient care and found that 17% of the gloves were contaminated with MRSA.

MRSA is Everywhere:

To say that MRSA is everywhere is a bit of an exaggeration, but MRSA is very common in the healthcare environment. Methicillin-resistant *Staphylococcus aureus* has been found in significant amounts on mobile phones belonging to patients, visitors, and nurses, on stethoscopes, on computer keyboards, on x-ray cassettes, and on all kinds of surfaces such as countertops and cloth curtains. The MRSA bacterium can live on these objects and surfaces for weeks and months and can easily be picked up and transmitted. A study performed in three community hospitals found that 12% of the surfaces tested were contaminated with MRSA.

Patient contact is so frequent, because MRSA is commonly found in healthcare facilities, and because MRSA is so easily transmitted, infections with MRSA are a significant risk for patients. MRSA is the leading cause of surgical incision infections, it is the second-leading cause of bacteremia (infection of the bloodstream) in certain patient populations, and it is a common cause of pneumonia in patients who are on ventilators. Patients who are elderly, who have a compromised immune system, who have received multiple antibiotics, who have in-dwelling catheters, and who have a long stay in the hospital are at risk for developing a hospital-acquired MRSA infection.

Community-Acquired MRSA Infections

Methicillin-resistant *Staphylococcus aureus* infections that are acquired in the community are transmitted by contact with an infected person or contact with a contaminated environment (just as hospital-acquired MRSA infections) and there are factors that increase the risk of developing a community-acquired MRSA infection. These risk factors

are called *the five Cs: Crowding, Contact, Lack of Cleanliness, Compromised Skin, and Environmental Contamination.*

Crowding:

There are many reasons why crowding increases the risk of contracting an MRSA infection. The greater the number of people in close proximity to one another, the greater the chances that there will be someone who has an MRSA infection. Crowding also limits a person's ability to avoid MRSA infections. Examples of crowded environments that increase the risk of developing an MRSA infection are day-care centers, dormitories, locker rooms, and correctional facilities.

Contact:

The more contact a person will have with others who have an MRSA infection or the more a person is exposed to an MRSA-contaminated environment, the greater the chances are that an MRSA infection will be contracted.

Lack of **C**leanliness:

If the environment is not hygienic or the people coming into contact with one another do not practice good hygiene, the chances of people developing an MRSA infection will be increased.

Compromised Skin:

An intact skin surface is one of the most important defenses individuals have against infections. Pathogens such as MRSA can live on the skin and cause infections. But most pathogens, MRSA included, will thrive if they can gain access to internal organs and tissues and

the bloodstream. The skin surface acts as a very effective physical barrier so that pathogens cannot gain access to the organs, tissues, and bloodstream. If there is a break in the surface of the skin, even a very tiny break, MRSA can gain access and spread.

Environmental **C**ontamination:

The more contaminated the environment is with MRSA, the greater the risk of developing an infection with MRSA. It should be remembered that MRSA can be almost anywhere, and it can survive on surfaces in the environment for a long time.

Children, military personnel, people who are incarcerated, athletes who play team sports (especially contact sports like wrestling) people who have insulin-dependent diabetes mellitus, and people who use IV drugs are likely to have one or more of the five Cs present.

MRSA Infection Types

The MRSA bacterium can cause an infection anywhere in the body. The most common sites of MRSA infections are: 1) skin and soft tissue, 2) the bloodstream, and 3) the respiratory tract, especially in hospitalized patients who are on ventilators. Other infections that can be caused by MRSA include bone and joint infections, infections of the heart muscle, brain infections, ocular infections, and urinary tract infections.

Community-acquired MRSA infections are primarily skin infections, and affect vulnerable groups such as children, military personnel, people who are immunocompromised. For example, people who are HIV

positive or have HIV/AIDS, people in correctional facilities, team sport athletes, IV drug users, and people who are sexually promiscuous.

Hospital-acquired MRSA can cause skin infections, but it can also cause bloodstream infections and respiratory infections, much more so than community-acquired MRSA. Vulnerable hospital patients who are susceptible to contracting an MRSA infection include the elderly, Intensive Care Unit (ICU) patients, ventilated patients, hemodialysis patients, people who are hospitalized for a long period of time, people who have a surgical incision, people with certain chronic medical conditions, and people who have indwelling IV catheters or some other implanted medical device.

Skin Infections

Skin infections are the most common MRSA infections, and there are many different types of skin infections that can be caused by this pathogen. The most dangerous MRSA-related skin infection is necrotizing fasciitis, the infection that is sometimes called the "flesh-eating disease." Necrotizing fasciitis has been the focus of many sensational stories, and it is a very dangerous condition for several reasons.

First, necrotizing fasciitis can be difficult to diagnose because it is the fat tissue that is affected, not the skin. Because the tissues that are being destroyed cannot be seen, the area that is infected will look normal but the patient will complain of intense pain. Second, once the infection begins to progress, it can rapidly cause fever, tachycardia, and significant swelling. If the infection is not quickly diagnosed and treated, the skin can be destroyed quickly; the rate at which tissue is

destroyed or "eaten" can be extremely fast. And third, even with early detection and the proper treatment, the mortality rate from necrotizing fasciitis has been reported to be between 30-40%, and the rate of amputations has been reported to be between 12-63%.

Most people who develop necrotizing fasciitis have chronic medical problems that affect their immune system or make them susceptible to infections, and include health problems such as diabetes mellitus, HIV/AIDS, obesity peripheral vascular disease, or alcohol, IV drug, or tobacco use. Fortunately, necrotizing fasciitis is quite rare; there are usually only 1000 cases reported in the United States each year. The great majority of skin infections caused by MRSA are conditions such as abscesses, boils, cellulitis, and surgical incision infections. These can be painful and quite disturbing for the patient but they are rarely as serious as necrotizing fasciitis. Most community-acquired MRSA infections are skin infections.

Bloodstream Infections

Bloodstream infections can cause a condition called sepsis. Sepsis occurs when a pathogen is present in large numbers in the bloodstream, allowing the harmful bacteria or virus to infect multiple organs. Sepsis that is caused by MRSA is a very dangerous condition. The mortality rate of MRSA-related sepsis is very high, and MRSA-related sepsis is very difficult to successfully treat. An MRSA-related sepsis usually happens to vulnerable people who are hospitalized.

Respiratory Infections

Community-acquired MRSA pneumonia is much less common than hospital-acquired MRSA pneumonia. People who are susceptible to

developing community-acquired MRSA pneumonia are the elderly and people who have HIV/AIDS, cardiac disease, diabetes mellitus, or lung disease. Hospital-acquired MRSA pneumonia is one of the most common types of hospital-acquired pneumonia. It is common in patients who are in ICUs and ventilated patients, and as with the community-acquired type of MRSA pneumonia, hospital-acquired MRSA pneumonia tends to affect the elderly and people who have HIV/AIDS, cardiac disease, diabetes mellitus, or lung disease. A significant number of people with hospital-acquired MRSA pneumonia will also develop an MRSA-related bloodstream infection.

Treatments for MRSA Infections

Healthcare-associated and community-associated MRSA has been reported to respond to specific antibiotics. While antibiotics may not always be necessary, such as with the drainage of a superficial abscess, this section will cover the varied treatments for an MRSA infection.

Skin Infections

Skin infections caused by an MRSA infection that have formed an abscess are often treated by a procedure called *incision and drainage*, more commonly known as an I & D. The skin over the area of infection is opened with a scalpel (the incision) and the pus is drained. An I & D may be done in a physician's office, a short-stay procedure unit, or an operating room. The choice of where and how to perform an I & D will depend on the size of the abscess, the location of the abscess, and the patient's age and medical history. If the patient is very young or very old, if the abscess is near a major blood vessel, or if the patient has

significant medical problems the I & D may be performed using general anesthesia in an operating room.

After the I & D is performed, the physician may or may not pack the wound and place a drain. The usefulness of these therapies is still being debated. Regardless of how and where an I & D is done, the patient will be prescribed antibiotics, usually both before and after the procedure. Less complicated MRSA skin infections are typically treated with antibiotics and warm compresses. Necrotizing fasciitis is treated with admission to the hospital and IV antibiotics.

The oral antibiotics that are used to treat simple MRSA skin infections include: trimethoprim-sulfamethoxazole (Bactrim), doxycycline, clindamycin, linezolid, tetracycline, and minocycline. If the infection is more complicated, then these IV antibiotics may be used: daptomycin (Cubicin), linezolid (Zyvox), and vancomycin (Vancocin).

Bloodstream Infections

Someone with an MRSA bloodstream infection will be admitted to the hospital if not already a patient. Bloodstream infections and sepsis caused by MRSA are usually treated with IV daptomycin, gentamicin, rifampin, or vancomycin,

MRSA-Related Pneumonia

Clindamycin, linezolid, or vancomycin are usually the drugs of choice for treating MRSA-related pneumonia.

Prevention of MRSA Infections

It is unlikely that all hospital-acquired MRSA infections can be prevented. The MRSA bacterium is very common in hospitals and healthcare facilities and some patients are very susceptible to MRSA infections.

Although MRSA infections probably cannot be eliminated, the incidence of MRSA infections can be reduced, especially in healthcare facilities. Decreasing the number of MRSA infections can be accomplished by using these three methods: 1) Identification of MRSA carriers and decolonization of the carriers, 2) Strict adherence to the principles and practices of Standard Precautions, and 3) The judicious use of antibiotics. The proper use of antibiotics in order to prevent antibiotic resistant strains of *Staphylococcus aureus* from developing is a very complex medical subject, and will not be discussed in this section.

Identification and Decolonization of MRSA Carriers

Identification of MRSA carriers is a commonly employed strategy that is used to prevent MRSA infections in healthcare facilities. People who are admitted to healthcare facilities who are considered to be high risk for being MRSA carriers are screened by applying a swab to the areas where MRSA is typically found; the axillae (armpits), perineal area, the inside of the nose, and the throat.

Colonization with MRSA does not necessarily mean that an MRSA infection is present. Many individuals can have pathogens growing on the skin, but there will not be enough of them to cause an actual infection, for example, a clinical illness with signs and symptoms. Colonization simply indicates that the MRSA bacterium is present on

the body. Remember, many people have MRSA growing on their skin for short periods of time.

If the patient is found to be an MRSA carrier, he/she will be isolated from vulnerable patients and from patients who are not MRSA carriers. The patient is then decolonized. Decolonization is a process by which the MRSA bacteria on the skin and in the nose is eliminated or greatly reduced. The decolonization procedure can be done in different ways in different healthcare facilities, but decolonization typically involves the following: 1) Application of a nasal antibiotic ointment, mupirocin (Bactroban). This is done twice a day for five days. 2) Skin washing with a chlorhexidine-containing wash such as Hibiclens for five days. 3) Five days of using an oral rinse that contains chlorhexidine, rinsing twice a day. Chlorhexidine is an antimicrobial that is effective in killing MRSA.

Screening and decolonization can be a very effective way of preventing MRSA infections. A 2013 study that was published in the New England Journal of Medicine showed that screening and decolonization of a targeted patient population was safe and reduced MRSA infections by forty-four percent.

Standard Precautions

The incidence of hospital-acquired MRSA infections can be dramatically decreased with strict adherence to infection control measures and especially so if healthcare personnel conscientiously use Standard Precautions. Standard Precautions are infection control techniques and procedures that are used to prevent the transmission and spread of

pathogens, and they are the most effective way of preventing the spread of MRSA and preventing hospital-acquired MRSA infections.

Standard Precautions are a combination of Universal Precautions (The original standards for the preventing the spread of pathogens), blood-borne pathogen precautions, respiratory and cough etiquette, safe injection practices, and the use of personal protective equipment (PPE).

Complete information on Standard Precautions can be found on the website of the Centers for Disease Control and Prevention (CDC) at: http://www.cdc.gov/HAI/settings/outpatient/basic-infection-control-prevention-plan-2011/standard-precautions.html. Another good source for information about infection control practices in the healthcare setting is from the World Health Organization (WHO) website at http://www.who.int/csr/resources/publications/4EPR_AM2.pdf.

The basic highlights of Standard Precautions will be covered next in the following sections.

Hand Hygiene

Handwashing is probably *the* most important way of preventing transmission of MRSA. It has long been proven that pathogens can be easily spread from patient to health care worker and then to other patients. This spread can be caused by even minimal contact and in situations in which contamination of the hands would not be obvious. If healthcare personnel strictly adhere to proper handwashing protocols, transmission of MRSA from patient to patient can be

reduced and the rate of MRSA infections can be reduced. The basic rules of handwashing are as follows.

Handwashing should *always* be performed before and after patient contact, even if the contact is minimal. Handwashing can be done using an alcohol hand rub. When using an alcohol-based hand rub, the healthcare worker should apply the product to the palm of one hand and rub both hands together. Making sure all surfaces of the hands and fingers are covered, the healthcare worker should rub the hands together until the hands are dry. The amount of hand rub that should be used will vary depending on the specifics of the product.

Alcohol-based hand rubs are a very effective method for cleaning hands. Using these products takes less time than washing the hands with soap and water, they remove more bacteria than soap and water, and they are less irritating to the skin than repeated hand washing with soap and water. The last point is very important for two reasons. First, people are less likely to wash their hands if their skin is chapped and irritated from constant washing with soap and water. Second, chapped and irritate skin places the healthcare worker at risk for infection; intact skin is the body's first line of defense against infection. Alcohol-based hand rubs can also irritate the skin but to a lesser degree than handwashing. Alcohol-based hand rubs should not be used if the hands are visibly dirty or contaminated with blood or other body fluids.

If handwashing with soap and water is necessary, the following rules should be observed. First remove all jewelry rings and bracelets. Wet the hands thoroughly, apply the soap and then rub the hands together

vigorously for at least 15 seconds, making sure to cover all the surfaces. Dry them with a paper towel and use the paper towel to turn off the water; do not touch the faucet handle with the just-washed hands. Healthcare workers should avoid wearing artificial nails and keep natural nails less than one quarter of an inch long if they care for patients at high risk of acquiring infections.

Gloves

Gloves are an important part of infection control and preventing the spread of MRSA. Handwashing itself cannot remove all pathogens from the hands or prevent contamination of the hands, so gloves must be used when contamination is likely. The use of gloves does not eliminate the need for hand hygiene. Likewise, the use of hand hygiene does not eliminate the need for gloves. Gloves can reduce contamination of the hands by 70% to 80%, but the use of gloves does not mean that handwashing can be ignored.

Disposable gloves should be used whenever there is a chance that the healthcare worker may come in contact with blood or other body fluids or secretions. In order to be effective, gloves must be used in the correct way. The healthcare worker must always wash the hands before putting on gloves *and* after taking them off; this step should not be skipped. Disposable gloves, either latex or non-latex, are not 100% impenetrable and it is also possible that small punctures to hand gloves could occur that the healthcare worker might not notice during patient care, so healthcare workers should not forget to wash their hands after removing gloves.

Putting gloves on and taking them off must be done properly. To remove gloves, grab the outside of one glove with your gloved hand and peel off the glove. For the other glove, slide the fingers underneath the glove and peel it back. Do not touch the outside of the gloves with bare hands when putting them on or when taking them off.

Healthcare workers should always discard used gloves in a hazardous waste container, and not discard them into an ordinary trash receptacle. Disposable gloves are a one-time use article. They should not be washed and reused, and should never be used to provide care for more than one patient

Personal Protective Equipment

Personal protective equipment (PPE) includes gloves, gowns, shoe covers, face masks, goggles, and respirators. Personal protective equipment is used to protect the healthcare worker from contamination with blood or other body fluids and secretions. The specific PPE that should be used depends on two factors: 1) the patient care situation, and 2) how likely it is the healthcare worker will be exposed to infectious material. For example, if the healthcare worker is going to perform urinary catheter care, disposable gloves and possibly a gown should be used but there would be no need for shoes covers, a face mask, or goggles. If asked to assist in a procedure that involved potential exposure to blood and the patient was agitated and confused, then more complete PPE would be appropriate for the healthcare worker. The facility in which the CNA works should have protocols that outline what level of PPE should be used for any specific procedure.

Personal protective equipment must be used properly. The healthcare worker should always wash the hands before putting on any article of PPE. Gloves should be the last item that are put on. When removing any article of PPE, the healthcare worker should not touch the outside of the mask, gown, glove, or shoe cover - the side that may be contaminated. The PPE items should be discarded in a hazardous waste container, not in an ordinary trash receptacle. PPE items should never be re-used and the same PPE items should never be used to provide care for more than one patient.

Blood-borne Pathogen Precautions

A complete discussion of blood-borne pathogen precautions is beyond the scope of this section. Methicillin-resistant *Staphylococcus aureus* infections can be spread by contact with blood, so any contact with blood, especially contact on non-intact skin, would pose a risk. The healthcare worker should always assume that blood may be potentially infectious and should use gloves and other PPE whenever contact with blood is likely to happen.

Respiratory and Cough Etiquette

Respiratory and cough etiquette can help prevent the spread of airborne pathogens. The etiquette has three parts: 1) Cover your mouth and nose with a tissue when coughing or sneezing, 2) Make sure to wash your hands after coughing or sneezing, and 3) Dispose of tissues in the nearest waste receptacle and wash the hands after using a tissue.

The most important basic principle behind Standard Precautions is that all body fluids and secretions must be considered potentially

contaminated and infectious. The healthcare worker should also keep in mind that the transmission of MRSA can occur very easily, and it can occur in patient care situations that seem safe. Using Standard Precautions protects the patient and it protects the healthcare worker, as well. Using Standard Precautions can be time-consuming and inconvenient, but it provides invaluable protection against MRSA, both to the healthcare worker and to patients. It should never be assumed that patient contact is "safe." Standard Precautions should always be used.

Case Study: MRSA

The following case study was obtained from a PubMed Search and the authors reported the case of a 6-year-old boy referred to a tertiary children's hospital for a 6-day history of right lower abdominal pain and fever.

On physical examination the authors reported that the child's abdomen was soft but mildly tender. Blood tests were done and showed severe inflammation with an elevated white blood cell (WBC) count. Other laboratory workup included testing of the liver and of the immune system, which were all within normal limits. Contrast-enhanced computed tomography (CT) testing showed multiple lesions that suggested liver abscesses, and magnetic resonance imaging (MRI) showed inflammation of soft tissue around the left hip joint. Blood culture testing was done and turned out to be positive for MRSA with sensitivity to certain antibiotics.

The patient was eventually treated with intravenous vancomycin based on the blood culture results. After 10 days of treatment the patient's

fever and X-RAY findings did not improve. A liver abscess drainage procedure was done, however the child's clinical condition deteriorated with ongoing high fevers and worsening pain in the left thigh. Urgent incision and drainage of soft tissue abscesses around the left femur were performed and the tissue fluid showed MRSA, and sensitivity to antibiotics was the same as for the prior testing. After 4 days of drainage of soft tissue abscesses around the left femur, the patient was no longer feverish.

The treatment course of the patient after discharge included outpatient follow-up, blood tests, and X-RAY testing. The patient was in good condition and free of pain. An ultrasonography test was done 7 weeks after the initial drainage showed resolution of liver abscesses. During 2 years of follow-up, the patient remained in predominantly good health.

Liver abscesses in children generally includes right upper quadrant pain and fever and laboratory investigations show elevated white blood cells needed to fight the infection. Ultrasonography, CT, and MRI play important roles in the diagnosis if liver abscess and patients can also undergo CT and ultrasound guided drainage of the abscess.

Causes of liver abscess have considerably changed over the past several decades. Liver abscess due to MRSA is uncommon and recovery of liver abscess from MRSA is extremely rare. Common bacteria associated with liver abscess includes *Escherichia coli*, group D *Streptococcus*, and *Klebsiella pneumoniae*.

The first priority when blood culture is positive for MRSA in a feverish child is to investigate the source of MRSA. Treatment of liver abscess

involves drainage and antibiotic therapy. After antibiotic treatment, the culture results need to be followed and specific antibiotic therapy must be started. In this case of an infected child, although MRSA could be successfully treated by vancomycin was seen, liver abscesses did not disappear with antibiotic treatment alone.

In this patient, additional interventional treatment with liver abscess drainage was done, which failed to relieve the child's high fever. The most likely explanation as to why the patient failed to respond to initial therapy is formation of soft tissue abscesses around the left femur. The satisfactory clinical result after incision and drainage of soft tissue supports this possibility.

Discussion

This case highlights the problem of community-acquired MRSA. Most MRSA acquired in the community has varied strength (also termed virulence). Community-acquired MRSA is more likely to cause cellulitis (infection of the skin) and abscesses than hospital acquired-MRSA, and is more susceptible to multiple antibiotics.

In the case of this child, the aggressive nature of abscesses suggests that the most possible cause of MRSA abscess in this patient was from soft tissue infection. The MRSA infection was susceptible to several types of antibiotics and antibiotic therapy for a liver abscess is generally 2 to 6 weeks. This patient recovered after adequate drainage of an MRSA abscess and a complete course of antibiotics. There was no recurrence of MRSA infection in this case in the last follow-up at 2 years.

Summary

Methicillin-resistant *Staphylococcus aureus* is a dangerous pathogen, a mutation of the *Staphylococcus aureus* bacterium that has the ability to resist treatment by many of the commonly used antibiotics. Infections with MRSA usually affect the skin, the respiratory tract or the bloodstream, but the heart, the brain, the urinary tract, and other areas of the body can develop MRSA infections.

The MRSA bacterium is very common, and many people have MRSA, for short periods of time, in their nasal passages and on the skin in the armpits, groin, and the oropharynx. Methicillin-resistant *Staphylococcus aureus* is also a commonly found environmental contaminant, especially in health care facilities. Although many of us have MRSA and MRSA often contaminates many objects and surfaces in the environment, infections with MRSA usually happen only in certain conditions and to people who are vulnerable.

Unfortunately, if an MRSA infection does occur it can be difficult to treat and for some patients who have MRSA infections of the blood stream or the respiratory tract, the mortality rate can be high. Skin infections with MRSA are less dangerous, but one particular type of MRSA skin infection, necrotizing fasciitis - commonly called the flesh eating disease - is difficult to diagnose and treat and is associated with high rates of mortality and amputation.

Infections with MRSA can be prevented by identifying and decolonizing MRSA carriers and by the conscientious use of Standard Precautions. Although these measures cannot completely eliminate MRSA

infections, they have been shown to significantly decrease the number of people who develop MRSA infections.

A rare case of liver abscesses with soft tissue infection caused by MRSA was presented. MRSA must be considered as a possible source of liver abscess in patients with skin and soft tissue infections, especially without obvious gastrointestinal sources. Drainage of the infected area and starting antibiotics should be considered as a standard treatment of MRSA abscesses in order to reduce the risk of worse illness and death, and to improve the quality of life.