Methicillin-Resistant Staphylococcus Aureus (MRSA) A Challenge for Infection Control

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MRSA is a term applied to a special strain of staphylococci called Methicillin-resistant staphylococcus aureus that is resistant to antibiotics called beta-lactams. Beta-lactam antibiotics include methicillin and other more common antibiotics such as oxacillin, penicillin and amoxicillin. Beta-lactams also include cephalosporines and carbapenams. This strain of organisms began to be seen in the late 1970s in academic medical centers by the late 1980s, MRSA strains were encountered in all acute care hospitals of any size[1].

Classification

MRSA infections can be classified into hospital-acquired MRSA (HA-MRSA), and community acquired MRSA (CA-MRSA). CA-MRSA is acquired by persons who have not been recently (within the past year) hospitalized or had a medical procedure (such as dialysis, surgery, catheters). These infections manifest usually as skin infections, such as pimples and boils and occur in otherwise healthy people[2]. Hospital-acquired MRSA (HA-MRSA) infection is acquired by persons admitted to hospitals for more than 48 hours or those have medical history of MRSA infections or colonization during previous admission. Common sites of HA-MRSA are surgical wound infections, urinary tract infections, and pneumonia[3]. A surgical wound infection (SWI) is a term that was changed according to CDC (Center of Disease Control) to surgical site infections (SSI). These categories of infections represent the third most common nosocomial infections. While nosocomial pneumonia represent the second most common cause of nosocomial infections (12.5%)[4].

Mode of transmission

Transmission of MRSA occurs mainly by contact transmission and droplet infection.

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Contact transmission occurs via hands which may become contaminated by contact with colonized or infected individuals, colonized or infected body sites of other persons, devices and environmental surfaces already contaminated with body fluids containing MRSA.

Surgical wound infection and contamination occurs mainly through contact with hands of health care workers or environmental surfaces contaminated with body fluids containing MRSA. Droplet infection is another type of transmission which causes pneumonia and in such a case, the patient is infectious through droplet infections to the surrounding patients and health care workers.

Other factors contributing to transmission include skin-to-skin contact, crowded environment conditions, and poor hygiene. And while 25% to 30% of population is colonized with staphylococcus aureus, approximately 1% is colonized with MRSA[5]. So, health care workers (including physicians, nurses, and paramedicals) who carry MRSA colonies in their nostrils and skin are responsible for increased risk of getting surgical wound infections to patients when they deal with.

Pathogenesis

Staphylococcal resistance to oxacillin/methicillin occurs when an isolate from infected patient carries an altered penicillin- binding protein, PBP2a, which is encoded by the mec A gene[6] The new penicillin-binding protein binds beta lactams with lower avidity which results in resistance to this class of antimicrobial agents.

Diagnosis

Diagnosis of MRSA infections depend upon the site of infection.

In wound infections, you have to swab the wound for culture.

In pneumonia, you will obtain a sputum culture (weather expectorated purulent sputum, respiratory lavage, or bronchoscopy guided biopsy for culture).

While in urinary infections, you have to obtain urine culture using aseptic precautions.

It is difficult to detect methicillin resistance – but when used correctly, broth – based and agar-based susceptibility tests usually detect MRSA. PCR test can be used to detect the mec A gene,

which mediates the methicillin resistance in staph[7,8].

Preventive strategies

The Main Goals

1. Prevent or minimize transmission.
2. The use appropriate antibiotic protocol aiming for reduction of emergence of this resistant strain.

Methods to control transmission

1. Standard Precautions could control the spread of MRSA in most instances.
2. Also contact precautions are required to control the spread of MRSA infections in surgical wounds.

Standard precautions include:

1) Hands washing

Wash hands after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn. Wash hands immediately after gloves are removed, between patient contacts, and when otherwise indicated to avoid transfer of microorganisms to other patients or environments. It may be necessary to wash hands between tasks and procedures on the same patient to prevent cross-contamination of different body sites[9].

2) Gloving

Wear gloves (clean nonsterile gloves are adequate).

3) Masking and eye protection

Wear a mask and eye protection or a face shield to protect mucous membranes of the eyes, nose, and mouth during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions[10]

4) Gowning

Wear a gown (a clean nonsterile gown is adequate).

5) Appropriate device handling

6) Appropriate handling of laundry

If MRSA is judged by the hospital's infection control program to be of special clinical or epidemiologic significance, then Contact Precautions should be considered.

Contact Isolation Precautions consist of:

1. Placing a patient with MRSA in a private, isolated room. When such a room is not available, the patient may be placed in a room with a patient(s) who has active infection with MRSA, but with no other infection.
2. Wearing gloves (clean non-sterile gloves are adequate) when entering the room. During the course of providing care for a patient, change your gloves after having contact with infective material that may contain high concentrations of microorganisms (e.g., fecal material and wound drainage). Remove gloves before leaving the patient's room and wash hands immediately with an antimicrobial agent.
3. Wearing a gown when entering the room if you anticipate that your clothing will have substantial contact with the patient, environmental surfaces, or items in the patient's room, or if the patient is incontinent, or has diarrhea, an ileostomy, a colostomy, or wound drainage not contained by a dressing.
4. Limiting the movement and transport of the patient from the room to essential purposes only.
5. Ensuring that patient-care items, bedside equipment, and frequently touched surfaces receive daily cleaning.
6. When possible, dedicating the use of non-critical patient-care equipment and items such as stethoscope, sphygmomanometer, bedside commode, or electronic rectal thermometer to a single patient (or cohort of patients infected or colonized with MRSA) to avoid sharing between patients.[11]

Preventive measures for MRSA carrier

1. The staff member (health care workers) may have to temporary cease work with surgical patients until cleared of the organisms.
2. Use an antiseptic as chlorhexidine on the affected skin.
3. Mupirocin topical application for nasal carriage.
4. Ciprofloxacin and rifampin for chronic carriers.

Treatment

The choice of antibiotic treatment of MRSA infection depends upon culture and sensitivity tests to choose the sensitive drugs.

Vancomycin, Teicoplanin and two newer antimicrobial agents; Linezolid and Daptomycin[12], are among the drugs used for treatment of severe cases of MRSA infections. Vancomycin could be given in a dose of 500 mg by slow intravenous infusion (to avoid hypotension) every 6 – 8 hours for at least 5 days up to 14 days in severe infections with MRSA. Patients should be monitored for sensitivity reactions (Red Man's syndrome)[13] and possible drug nephrotoxicity. Although some strains remains susceptible to trimethoprim-sulphamethoxazole, gentamycin, or rifampin, these drugs are not typically used as first-line agent in severe infections – but that may be given in case of contamination or mild infections of surgical wound with MRSA strains.

Control of MRSA Outbreaks

When an outbreak of MRSA infection occurs, an epidemiologic assessment should be initiated to identify risk factors for MRSA acquisition in the institution; clinical isolates of MRSA should be saved and submitted for strain typing. Colonized or infected patients should be identified as quickly as possible. Appropriate barrier precautions should be instituted, and hand washing by medical personnel before and after all patient contacts should be strictly adhered to.

Vancomycin Resistance

According to CDC, there are important types of strains emerged in relation to vancomycin resistance which are VISA (vancomycin intermediate staphylococcus aureus) with reduced susceptibility to vancomycin, VRSA (vancomycin resistant staphylococcus aureus), and VRE (vancomycin resistant enterococci). Vancomycin resistance could be attributed to inadequate treatment with the drug, poor penetration of it into abcesses, limited concentration in same body fluids as bile, and subtherapeutic vancomycin dosing[14].

In June 2000, a case study was done on a VISA stain isolated from a patient underwent a complicated cholecystectomy. Stoppage of vancomycin treatment was done after confirmation of VISA infection and combined treatment of linezolid, trimethoprim-sulfamethoxozole, and doxycycline was successful to eradicate this infection[15].

Establishment of diagnosis of a resistant strain of staphylococcus aureus to vancomycin (either VISA or VRSA) necessitates strict standards and contact precautions (isolation) measures for all patients' contacts[16] and also notification of local health authorities and CDC.

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