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Investigation of Methicillin-resistant Staphylococcus aureus on Hospital Acquired Paitents

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Abstract

Methicillin-resistant Staphylococcus aureus (MRSA) remains a major public health issue in the world and a therapeutic challenge to be addressed. Infection with MRSA is one of the most common causes of nosocomial infections and is generally associated with high morbidity, mortality, duration of stay and cost. The bacterium that produces MRSA, staphylococcus aureus, is present in the skin, in the nose, in the bloodstream or in the urine. It affects a large proportion of inpatients and can be transferred between individuals. Resistance to methicillin in S. aureus is mediated by PBP2a, a penicillin-binding protein with low affinity to beta-lactams, encoded by the mecA gene. mecA code penicillin -binding protien 2a(PBP2a), an enzyme that causes cross-linking of peptidoglycans in the bacterial wall.PBP2a has a low affinity for B-lactamines, resulting in resistance to the entire class of antibiotics. The primary risk factor for MRSA infection in hospitalized patients is a weakened immunity system.Those at greatest risk of infection include infants, the elderly, chronic patients, burn survivors, organ transplant recipient cancer patients receiving chemotherapy agents, steroid users, diabetic patients, intravenous drug users, and those with AIDS. Diagnosis and Prevention of MRSA colonization in patients are important tools to limit the spread of this organism.

Keywords :- Peznicillin,Vancomycin, Pathogens, mecA gene

Introduction

Methicillin-resistant Staphylococcus aureus (MRSA) continues to be a leading bacterial pathogen resistant to methicillin causing serious health care and community-related infections. Resistance to methicillin in S. aureus is mediated by PBP2a, a penicillin-binding protein with low affinity to beta-lactams, encoded by the mec A gene [1]. MRSA infections can be further divided into hospital-associated (HA-MRSA) infections and community-associated (CA-MRSA) infections. They are distinguished not just by their clinical characteristics and molecular biology, but also by their sensitivity to antibiotics and their treatment[2]. Risk factors for MRSA-HA infection include time spent in hospital, exposure to antibiotics, and exposure to MRSA-infected individuals. External or community-based risk factors for CA-MRSA infection include exposure to a person with MRSA, generally skin-to-skin contact, and exposure to environments that favour overcrowding or lack of cleanliness [3]. MRSA continues to be one of the challenging pathogens in ESKAPE. (Enterococcus faecium, S. aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter species) ,although several new antiinfectious agents have been introduced over the last decade [4]. Penicillin was the first beta-lactam antibiotic developed for the treatment of S. aureus infections. penicillin is used to treat the patient with severe staphylococcal infections. MRSA infection is sometimes difficult to treat because it is resistant to multiple antibiotics and multiple virulence factors.Vancomycin was the drug of choice when treatment with lactam-free antibiotics was unsuccessful. However, over the past few years, the development of vancomycin-resistant S aureus (VRSA) has made it difficult to treat MRSA infections [5]. This review examines the risk factors of MRSA and novel approaches to laboratory diagnosis,Treatment,Prevention and control of MRSA infection.

Risk Factors for Nosocomial Methicillin-Resistant Staphylococcus aureus (MRSA)

- Prolonged hospital stay
- Exposure to broad-spectrum antibiotics
- Exposure to a greater number of antimicrobial agents
- Longer duration of antimicrobial therapy

- Stay in intensive care or burn unit
- Presence of surgical wound
- Proximity to another patient with MRSA (e.g., an infected roommate) [6].

Laboratory Diagnostic :- The first step in MRSA confirmation is to isolate S. aureus from a culture of blood, tissue ,surgical wounds,lesions ,abscess and pus. If there is no S. aureus in a culture, the individual is unlikely to have MRSA [7].

Specimen Collection and Transport :- Using a sterile swab of the environment (sponge swabs) moistened with buffered. peptone broth, various surfaces around shrines frequently visited by humans and monkeys were delicately sampled. the swabs collected were stored in the vial, capped with screws, clearly labeled and transported to the laboratory immediately to prevent contamination [8].

Specimen Processing :- Sample were first inoculated in nutrient agar (NA) and then subcultured in mannitol salt agar (MSA) and aerobically incubated for 24 hours at 37°C. Blood samples were inoculated on chocolate agar (CA) and then subcultured in MSA Bacterial colonies showing typical characteristics of S.aureus including golden yellow color colonies on MSA [9].

Antimicrobial susceptibility testing :- Susceptibility to confirmed S aureus antibiotics was evaluated with nine disc diffusion antibiotics, as normalized by the Clinical and Laboratory Standards Institute (CLSI) [10]. Antibiotics included methicillin (10 mg), oxacillin (1 mg), cefoxitin (30 mg),erythromycin (15 mg), gentamicin (10 mg), ciprofloxacin (5 mg),clindamycin (10 mg), co-trimoxazole (25 mg), and vancomycin (30 mg). All tests were carried out using Mueller-Hinton agar and interpreted after incubation at 37 8C overnight [11].

Treatment of MRSA

The treatment approach for MRSA patients is dependent on the site of infection and the choice of the antimicrobial agent against MRSA. Like other infectious diseases, the severity of the infection has important prognostic implications, but this is not a more important factor in choosing antibiotics [12]. The use of antibiotics to treat the infection should be contingent on the outcome of antimicrobial susceptibility tests,

although most of the strains seem ineffective during treatment, although sensitive in routine susceptibility [13]. Vancomycin has been the drug of choice to treat serious infections caused by methicillin-resistant Staphylococcus aureus (MRSA) over the past several decades [14] . Linezolide, daptomycin, telavancin and ceftarolin are drugs that have received regulatory approval over the past decade to treat infections caused by drug-resistant gram-positive pathogens. While these drugs have distinctive attributes and can provide some advantages over vancomycin [15].

Table 1 . Summary of antibiotics active against methicillin- resistant Staphylococcus aureus [16].

Sr.no.	**Antibiotic**	**Used for**
1	Vancomycin	Bacteraemia, pneumonia, osteoarticular infection,
2	Linezolid	Catheter- related MRSA bacteraemia
3	Daptomycin	Osteomyelitis
4	Clindamycin	ABSSSI, Osteomyelitis Pneumonia
5	Telavancin	Bacteraemia
6	Ceftaroline	Osteomyelitis,Pneumonia, endocarditis

*ABSSSI - acute bacterial skin and skin structure infections

Prevention for health care workers

Standard precautions are recommended to treat infected patients or those sensitive to the infection.The use of disposable gloves/washable gowns may prevent the transmission of MRSA.They would protect health care workers' hands and clothing against MRSA contamination. Gloves and gowns were discarded when a patient was treated, and clean gloves were used to visit the next patient. The use of masks could also prevent the

propagation of MRSA in air [17]. To interact with patients without known infections, hand hygiene is vital to prevent the transmission of MRSA, including the appropriate use of alcohol-based hand sanitizers. The practitioner is expected to wash hands thoroughly with soap and lukewarm water after working with each patient. Hand washing may be replaced with alcohol-based rubbing if the hands are not visibly contaminated [18].

Fundamentals to control the spread of Methicillin Resistant Staphylococcus aureus (MRSA)

There is no standard, one-size-fits-all approach to controlling MRSA within healthcare facilities. This requires infection control personnel to adapt their approach to the body's epidemiology and hospital resources. However, certain measures are applicable to most health institutions. These are the followings

Table 2. Describes important control measures on MRSA [19,20]

Sr.no.	**Surveillance**	**Microbiology support**
1	Examine culture and sensitivity test results on a regular basis.	Apply appropriate sensitivity testing methods
2	Keep a roster of patients known to be colonized or infected with MRSA	Alert clinicians and infection control personnel when MRSA isolates have been identified.
3	Conduct culture surveys to assess the prevalence of MRSA, when required	Record isolates if necessary, Perform or get molecular typing if needed.
4	Obtain surveillance cultures at intake of transferred patients from facilities known for their high prevalence of MRSA.	Reduce the use of antimicrobials.

Summary

MRSA is a common pathogen in a number of health care settings and communities around the world. It causes mild to severe infections that can be hard to treat due to its resistance to multiple antibiotics and the transport of multiple virulence factors. Over the years, laboratory methodology to detect methicillin resistance has been widely introduced and standardised, permitting accurate detection of MRSA strains from clinical specimens. In addition to adhering to infection control precautions, doctors should use antimicrobial agents appropriately to reduce the risk of selection of MRSA or other resistant organisms from the patient's microbial flora. Certain programs and interventions help to ensure that patients get the right antibiotics at the right time and for the right duration, reduce antibiotic resistance, reduce costs and improve patient outcomes.

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