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Review Article

Methicillin-resistant *Staphylococcus aureus* among healthcare workers: screening, risk factors and treatment

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ABSTRACT

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a common pathogen of clinical significance within the community and healthcare settings. It has been reported with a variety of infections, including endocarditis, bloodstream infections, pneumonia, joint and bone infections, and soft tissue and skin infections. Although many efforts have been exerted to eradicate the rates of infections and studies have reported a decreasing pattern in the prevalence rates over the years, it has been demonstrated that MRSA represents a significant challenge to the healthcare systems and the affected patients. In this literature review, we have provided a discussion regarding the risk factors, screening, and treatment of MRSA among healthcare workers (HCWs) based on the evidence obtained from the current relevant studies in the literature. HCWs are at increased risk of MRSA colonization, and many risk factors have been identified. These mainly include poor hygiene practices, chronic skin diseases, and having a history of working in an MRSA-endemic country. Decolonization practices are the main line of treatment of MRSA colonization among HCWs because antibiotic therapy is usually of limited use because of the increasing resistance to a wide range of antibiotics. Applying adequate interventions as taking care of hand hygiene and using alcohol-based disinfectants is recommended to achieve better outcomes. Increasing awareness among HCWs is also a potential approach to achieve better management.

Keywords: Decolonization, MRSA, HCWs, *Staphylococcus aureus*

INTRODUCTION

MRSA is a common pathogen of clinical significance within the community and healthcare settings. It has been reported with a variety of infections, including endocarditis, bloodstream infections, pneumonia, joint and bone infections, and soft tissue and skin infections.[1] Although many efforts have been exerted to eradicate the rates of infections and studies have reported a decreasing pattern in the prevalence rates over the years, it has been

demonstrated that MRSA represents a significant challenge to the healthcare systems and the affected patients.[2] Accordingly, the world health organization lists the organism as a target for management development and research practices. Resistance to many antibiotics was reported in the literature, which indicates the great threats that this pathogen poses.[1,3]

The most common route of transmission is done by contact, as it has been demonstrated that an infected or a carrier person can transmit the infection to another by direct contact.[4] Besides, infection within the healthcare settings requires the integration of three main parameters, including a source of infection, a susceptible host, and the presence of a suitable mode of transmission. Patients, HCWs, textiles, visitors, medical equipment, and other surfaces within the healthcare settings are considered as sources for infections.

The prevalence of MRSA infection among HCWs has been estimated to be up to 5%.[5,6] Although the risk and prevalence of occupational infections seem to be low as compared to other diseases, it should be noted that these infections can cause serious adverse events and complications. Therefore, adequate management should be implemented to enhance the associated outcomes. In this literature review, we aim to discuss the risk factors, screening, and treatment of MRSA among HCWs.

This literature review is based on an extensive literature search in Medline, Cochrane, and EMBASE databases on which was performed 20th August 2021 using the medical subject headings (MeSH) or a combination of all possible related terms.[7,8] This was followed by the manual search for papers in google scholar while the reference lists of the initially included papers.[9,10] Papers MRSA among HCWs were screened for relevant information, with no limitation on date, language, age of participants, or publication type.

DISCUSSION

Risk factors

Many risk factors for MRSA infections among HCWs have been identified, and the major factors are poor hygiene practices, chronic skin diseases, and having a history of working in an MRSA-endemic country.[6] Many previous studies have demonstrated that various skin diseases and lesions might attribute to being infected with MRSA.[11,12] Accordingly, it has been indicated that HCWs with colonized MRSA infections usually have chronic skin diseases.[13,14] During work, HCWs have an increased risk of being exposed to skin lesions. This is more obvious among nurses as it has been estimated that they usually suffer from hand eczema as a result of the huge burden that relies on them, which necessitates frequently wearing of gloves and the subsequently increased frequencies of hand washing and using disinfectants. Therefore, their skin is frequently exposed to wet and irritative materials.[15,16] This will significantly lead to a significant impairment in the skin barrier functions, which will aid in the colonization process of MRSA infections. A previous investigation in Germany by Brans et al reported that among nurses with severe occupational skin diseases, the prevalence of MRSA colonization was estimated to be 13.5%.[17] Therefore, it has been concluded that this estimated rate among German nurses was 2-3 times higher than the estimated point-prevalence rate among German HCWs, indicating the effect of skin lesions on the risk of MRSA colonization on HCWs.[12,18,19] The authors of this German study also reported that severe hand eczema, a history of atopy, and currently having atopic dermatitis were the main risk factors for MRSA colonization among the included nurses. On the other hand, it was also reported that reduced risk of MRSA carriage was associated with having psoriasis in this population. Accordingly, it has been suggested that skin diathesis increases the risk of developing hand eczema and MRSA carriage events.[20] The degree of impairment of skin barrier functions significantly correlates with the severity of eczema, and therefore, it can significantly impact the frequency of colonization.[21] Besides, it has been reported that increased inflammation secondary to the release of exotoxins from the infecting bacteria might also be another contributing factor to the development of MRSA colonization.[22,23] This was furtherly indicated by previous studies that indicated that the presence of *Staphylococcus aureus* was significantly associated with the severity of eczema.[24,25] Besides, severe hand eczema might subject the affected HCWs to reduce the frequency of using hand disinfectants to overcome the burning sensations that usually result from using these products. Accordingly, reduced hand hygiene might also contribute to MRSA carriage and colonization. In this context, it has been indicated that hand contamination can be the main route to MRSA transmission.[26]

Screening

MRSA screening is usually performed for patients among the different countries. However, the evidence regarding HCWs is still poor according to the current studies in the literature.[5,6,27] Furthermore, it has been demonstrated that if HCWs required hospital care, they should be treated as being risky patients and should be screened for MRSA colonization. In this context, it has been demonstrated that additional swabs from the affected parts should be taken from HCWs suffering from chronic skin diseases, like hand eczema.[6] It should be noted that performing a thorough and systemic screening is only suggested in cases when acute outbreaks of MRSA occur at the different workplaces of the HCWs. In a previous investigation in the Netherlands by Blok et al the authors indicated that although the prevalence of MRSA is low across the country, screening of HCWs among the different work communities and workplaces was recommended.[28] Across the different countries and healthcare facilities, it has been recommended that

infected HCWs should be removed away from the healthcare facilities, in addition to the decolonization of the workplace, until adequate management of the MRSA outbreak has been achieved. However, the optimal management of the affected patients remains controversial among the different studies in the literature.[29,30]

Treatment

To achieve adequate management of MRSA among HCWs, various management modalities have been proposed in the literature, including decolonization, antibiotic therapy, and prevention. Decolonization can be achieved by the following measures, including 1) decolonization of the pharynx and throat by the administration of 0.1% chlorhexidine mouth rinse tid, 2) decolonization of the nasal atrium using mupirocin nasal ointment tid, 3) shower disinfection after personal use, 4) using antiseptic preparations to cleanse the surface of the skin once per day, 5) frequent changing of bed sheets, underwear, and towels daily, 6) frequently changing the personal tools following successful decolonization, and 7) disinfecting the toothbrush after each personal use using 0.1% chlorhexidine solution. All of these measures should be applied for at least five consecutive days to achieve the proposed outcomes.[31,32] To achieve adequate topical decolonization of the nasal atrium, mupirocin has been reported to be the drug of choice in such cases. However, it should be noted that the drug should be topically used only and not administered for treating dermatological lesions, in general, to intervene against the development of any potential resistance to the modality by MRSA. However, if resistance was observed, the administration of other topical antibiotics as lysostaphin or bacitracin, or antiseptics as octenidine can be effectively used, instead. Conducting routine swabs is recommended to follow up on the efficacy of the treatment modalities and the status of colonization. Nevertheless, no specific protocols or guidelines have been validated in the literature for the follow-up plans. A previous recommendation suggested that HCWs should be subjected to cultures every three consecutive days starting on the 3rd day from decolonization.[33] Besides, further swabs are also encouraged at days 10, 30 and 90 for further validation and indications of achieving successful decolonization outcomes. Nonetheless, another investigation by Frickmann et al reported that conducting a single-day swab on the 2nd day following decolonization measures had similar outcomes in identifying failure of colonization as compared to the aforementioned suggestion.[34] It has been estimated that the success rates of decolonization are variable and range between 23% and 96%.[35] Management of the risk factors and applying more than one treatment modality is recommended in cases of relapse or decolonization failure events. Colonization of extra nasal sites, especially the perineum, and other body sites is the main risk factor for decolonization failure and persistence of the infection.[6,36] Besides, it has been furtherly demonstrated that the presence of skin lesions is significantly associated with the presence and duration of MRSA colonization.[37] Clinicians should exclude the presence of mupirocin resistance. If persistence of MRSA carriage was observed even after repeated decolonization therapy, microbiological monitoring should be considered in these situations, in addition to the living conditions of the affected patients. Other suspected reservoirs and carriers of MRSA as pets, family members, and other subjects should be adequately managed because these have been reported to be significant sources for colonization and repeated infections.[36,38]

Topical and systemic treatment modalities have been proposed for the management of a confirmed MRSA infection. However, it has been reported that resistance to antibiotics has been recently increasing.[39] Accordingly, strain identification is compulsatory to decide the best treatment approach and achieve adequate eradication of the causative organism. In this context, it has been demonstrated that MRSA is not only resistant to methicillin, but also the entire modalities within the range of β-lactam antibiotics, including cephalosporins, penicillins, and carbapenems. Besides, it has been reported that some strains have further resistance against other antibiotic modalities. Therefore, it has been concluded that the administration of antibiotics for the management of MRSA is not very effective, and other treatment modalities should be used. Even if antibiotics are still considered, sensitivity tests should be used before initiating the treatment plan. For systemic therapy, glycopeptides like teicoplanin or vancomycin have been effectively reported to eradicate some strains of MRSA. However, resistance was detected in the United States.[40] Reduced resistance to doxycycline, cotrimoxazole, or rifampicin is reported in the literature, and therefore, these modalities might be used to achieve better outcomes. Moreover, oxazolidinone linezolid (daptomycin), and tigecycline (glycylcyclines) were also reported to be effective in the management of severe MRSA infections, like in cases of pneumonia, and bacteremia. On the other hand, it should be noted that rifampicin should not be used alone for eradicating MRSA infections and colonization.[41]

Furthermore, applying adequate interventional modalities can be the key solution against MRSA colonization and can lead to significant eradication of the infection rates. Hand hygiene is an important measure that should be routinely done, however, its efficacy on the barrier functions is still not completely understood. In addition to not being adequately studies, it has been demonstrated that increased hand pH and contact dermatitis might be adversely associated with the recommended hygiene measures. Accordingly, validating modalities that can maintain suitable pH values of the hands of the HCWs has been proposed, however, it is adequately studied.[42] Although topical leave-on or rinse-off products might have positive effects, they can also adversely affect the skin of the HCWs leading to further development of

associated complications and colonization when improperly used. Additionally, previous studies have demonstrated that the efficacy and tolerance of alcohol are superior to that of soaps in achieving disinfection.[43,44] Accordingly, using alcohol-based disinfectants is recommended to HCWs to achieve adequate hygiene and to intervene against the potential adverse events that might result from frequent hand washing.[45] Applying guidelines or protocols for systemically managing the infection among HCWs can also increase the compliance among these workers, and reduce the rates of infections.

CONCLUSION

HCWs are at increased risk of MRSA colonization, and many risk factors have been identified. These mainly include poor hygiene practices, chronic skin diseases, and having a history of working in an MRSA-endemic country. Furthermore, decolonization practices are the main line of treatment of MRSA colonization among HCWs because antibiotic therapy is usually of limited use because of the increasing resistance to a wide range of antibiotics. Applying adequate interventions as taking care of hand hygiene and using alcohol-based disinfectants is recommended to achieve better outcomes. Increasing awareness among HCWs is also a potential approach to achieve better management.

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