Meticillin-resistant staphylococcus aureus (MRSA)

What is MRSA?

Staphylococcus aureus is a Gram-positive bacterium that colonises the skin; nasal carriage occurs in about 25-30% of healthy people. Meticillin-resistant *S. aureus* (MRSA) is usually acquired during exposure to hospitals and other healthcare facilities and causes a variety of serious healthcare-associated infections. However, 1-3% of the total population are colonised with MRSA and in most cases no treatment is necessary, as colonisation does not lead to any harmful infection.[1]

Meticillin resistance is clinically very important because a single genetic element confers resistance to the the beta-lactam antibiotics, which include penicillins, cephalosporins and carbapenems. Over the period of 20-30 years, MRSA strains have been present in hospitals - hospital-acquired MRSA (HA-MRSA); they have become a major cause of hospital-acquired infection. Community-acquired MRSA (CA-MRSA) emerged worldwide in the late 1990s.[2]

Most MRSA infections in the UK that appear to have a community onset occur in patients who are found to have had direct or indirect contact with hospitals, care homes or other healthcare facilities. These MRSA strains are typical of the local HA-MRSA and may be carried asymptomatically by patients for months after discharge. However, new strains of MRSA have emerged that cause infections in community patients who have no previous history of direct or indirect healthcare contact.

CA-MRSA strains are genetically and phenotypically distinct from HA-MRSA. They often produce Panton-Valentine leukocidin (PVL) and PVL-producing strains of CA-MRSA appear to be associated with increased risk of transmission, complications and hospitalisation. See also separate PVL-positive Staphylococcus Aureus article.

Spread from person to person is by direct contact with the skin or via a contaminated environment or equipment. Staphylococci that are shed into the environment may survive for long periods in dust. Skin scales may contaminate if they become airborne - eg, during activities such as bed-making, or if the affected person is heavily colonised or has a condition such as eczema which causes shedding of high numbers of organisms.

How common is MRSA? (Epidemiology)

The surveillance of MRSA in the UK is a mandatory scheme run by the Department of Health.[3]

- About 30% of the UK population are colonised with *S. aureus*,and 1-3% of the total population are colonised with MRSA. [1]
- Meticillin resistance rates of *S. aureus* vary considerably between countries. In the USA the figure is reported as 0.8-1.2% in the general population but 5% in hospitals[4] , although in HIV-positive individuals it has been found to be as high as 10-17%.[5] The figure in long-term facilities in France was 38%.[6]
- Public Health England data show a total of 694 cases of MRSA bacteraemia were reported by acute NHS Trusts in England between 1 April 2020 and 31 March 2021. This is a decrease of 14.7% from April 2019 to March 2020 (n = 814), and a decrease of 84.4% from April 2007 to March 2008 (n = 4,451. Generally there is a trend towards a decreasing number of cases .
- There is currently a requirement that all NHS organisations complete a Post Infection Review (PIR). Monthly MRSA bacteraemia data are then published on the basis of relevant PIR assignments (acute trust or CCG) by Public Health England.[7]

Risk factors

- MRSA is one of the most prevalent micro-organisms involved with healthcare-associated infections. It is usually confined to hospitals and in particular to vulnerable or debilitated patients; the presence of central venous catheters, sputum suction and hospital stays longer than 30 days are particular risks.[8]
- Some nursing homes have experienced problems with MRSA.
- MRSA does not pose a risk to hospital staff (unless they have a debilitating disease) or to family members of an affected patient or to their close social or work contacts.
- Specific risk factors for MRSA include:[1]
    - Critical or chronic illness, if also elderly or debilitated.
    - Presence of surgical wounds, open ulcers, intravenous lines and catheter lines.
    - Presence of an infected pressure sore.
    - History of MRSA colonisation or infection, or recent surgery.
    - Recent discharge from hospital.
    - Regular nursing home contact or a nursing home resident.
    - Recent antibiotic use (especially cephalosporins, fluoroquinolones and macrolides).
    - Dialysis.
    - Presence of a permanent indwelling urinary catheter.
    - HIV positivity (especially if young, male, recent incarceration in prison).
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- CA-MRSA is more often seen in young, healthy people[9] ; students, professional athletes and military service personnel.
- Risk factors for CA-MRSA skin infection include exposure to prisons, occupations or recreational activities with regular skin-to-skin contact (eg, wrestling), exposure to someone with MRSA or prior incarceration, exposure to antibiotics, intravenous drug abuse, recurrent skin infections and living in a crowded environment.[10]

Investigations

Rapid diagnosis of hospital-acquired infection is essential in order to start appropriate treatment early and also initiate procedures to prevent the spread of MRSA.

- Molecular testing methods - polymerase chain reaction (PCR) tests - are available to identify MRSA within several hours. PCR from culture samples may be used to detect the mecA gene, confirming the presence of MRSA. Fully automated commercial tests are now available.
- MRSA DNA has now been decoded and a test based on two duplex reactions run simultaneously can detect MRSA, meticillin-resistant coagulase-negative staphylococci and meticillin-susceptible *S. aureus* (MSSA).
- A PCR-free test available at the point of care has been developed.[11]

Additional investigations to consider include an FBC, blood culture and urine culture and sensitivities.[1]

MRSA treatment and management[12]

The falling prevalence of cases found in PHE reports provides some evidence that concerted efforts (including surveillance cultures, contact precautions and isolation in hospitals) can reduce MRSA even in endemic settings.

No one measure to control the spread of MRSA has proved to be effective. However, comprehensive MRSA control programmes, which have included screening cultures to detect patients (and in many instances staff) colonised with MRSA, use of contact precautions, appropriate hand hygiene and automatic alerts of re-admission of colonised patients, have reported success in controlling or reducing transmission of MRSA and also reduced acquisition of MRSA in high-risk units in hospitals. Further research on cost-effectiveness is required but evidence to date suggests that proactive measures to control the spread of MRSA in healthcare facilities are worth pursuing although antimicrobial drug stewardship is also proving a cost-effective method which limits the development of new multi-drug-resistant organisms.[13]

- Healthcare workers who are nasal carriers can serve as sources of MRSA transmission, although they are not nearly as important a reservoir as are colonised or infected patients. The cost-effectiveness of routine screening of all healthcare workers requires further research.[14]

- Screening of patients by culture of samples from body sites, such as the anterior nares, alone will identify 80% and screening from additional body sites in certain populations will increase the sensitivity to over 92%.[15] Screening of all patients admitted to intensive care units has been mandatory in England and Wales since 2010 and many hospitals have pre-admission screening policies for all patients prior to planned elective surgery.[16]

- Patients colonised or infected with MRSA should, whenever possible, be placed in a separate room, or kept with other patients who have MRSA.

- Transient contamination of healthcare workers' hands is widely believed to be the predominant method by which MRSA is transmitted to patients. Because healthcare workers' hands can become contaminated even when gloves are worn, hand hygiene is recommended after glove removal. Alcohol gel or other hand hygiene solutions are advocated as being easier and faster to use than soap and water.

- Decolonisation therapy can be considered for patients and staff.

Drugs[12] [17]

- Before treating, clinicians should seek advice from a local microbiologist. If MRSA is suspected because of previous colonisation/isolation, or is surgical/healthcare-related, it is very important to collect a microbiology sample.

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- Skin and soft-tissue infections:
    - Incision and drainage without the use of antibiotics may be sufficient treatment for small abscesses.
    - Clindamycin, co-trimoxazole or doxycycline should be considered as first-line treatments for mild skin infections.
    - A glycopeptide (vancomycin or teicoplanin) can be used for severe skin and soft tissue infections associated with MRSA; linezolid can be used on expert advice if a glycopeptide is not suitable.
    - A combination of a glycopeptide and sodium fusidate or a glycopeptide and rifampicin can be considered for skin and soft tissue infections that have failed to respond to a single antibacterial agent.
    - Tigecycline and daptomycin are licensed for the treatment of complicated skin and soft tissue infections involving MRSA.
- Respiratory tract infections:
    - A tetracycline or clindamycin can be used for bronchiectasis caused by MRSA.
    - A glycopeptide can be used for pneumonia associated with MRSA; if a glycopeptide is unsuitable, linezolid can be used on expert advice.
- Urinary tract infections
    - A tetracycline can be used for urinary tract infections caused by MRSA; trimethoprim or nitrofurantoin are alternatives.
    - A glycopeptide can be used for urinary tract infections that are severe or resistant to other antibacterial agents.

- Other infections:
    - A glycopeptide can be used for septicaemia associated with MRSA.
    - Endocarditis: vancomycin and low-dose gentamicin.
    - Osteomyelitis: vancomycin or teicoplanin - consider adding fusidic acid or rifampicin for an initial two weeks. Suggested duration of treatment is six weeks for acute infection.
    - Septic arthritis: vancomycin or teicoplanin. Suggested duration of treatment is six weeks.
- Prophylaxis with vancomycin or teicoplanin (alone or in combination with another antibacterial agent active against other pathogens) is appropriate for patients undergoing surgery if:
    - There is a history of MRSA colonisation or infection without documented eradication.
    - There is a risk that the patient's MRSA carriage has recurred.
    - The patient comes from an area with a high prevalence of MRSA.
- Mupirocin nasal ointment should be reserved for the eradication (in both patients and staff) of nasal carriage of MRSA. Alternative preparations such as chlorhexidine and neomycin cream (Naseptin®) should be considered if infection persists after two courses of mupirocin or if swabs confirm mupirocin resistance.

Care in the community [1] [18]

While the risk of serious infection with MRSA is low in the community, it still exists. Guidelines are regularly produced to guide management in community settings:

- Standard infection control procedures are important. MRSA-positive patients should not be isolated in community homes; instead, patients should socialise as normal. However, they should not share a room if they have a chronic open wound or invasive device, such as a urinary catheter.

- In the patient's own home there should be no restrictions to a normal life and people with MRSA can work and socialise as usual. They do not need to restrict contact with friends, children or the elderly. If they are admitted to hospital, where the risk of infection is increased, the ward should be informed so the patient is screened on admission and nursed appropriately.
- Community healthcare workers should practise standard infection control precautions, such as aseptic technique for wound care. They must decontaminate their hands before and after giving care, either by using soap and water or an alcohol hand rub.

Prognosis

MRSA is no more dangerous or virulent than other varieties of *S. aureus* but it is much more difficult to treat because the range of antibiotics which are effective against it is reduced.Particular risk factors for a worse prognosis are renal insifficiency and immunosuppression.[8]

MRSA Prevention[12]

All NHS patients going into hospital for a relevant planned procedure are now screened for MRSA beforehand.

Healthcare workers

Guidelines vary for screening of healthcare workers for MRSA but it is essential that all healthcare workers closely follow local guidelines. It has been shown that healthcare workers are a significant source of MRSA on hospital wards, especially from nasal and hand colonisation. Hand hygiene is particularly important even when in contact with presumed 'low-risk' sources in the patient's environment, such as medical notes and computers. Healthcare workers should therefore not work while known to be MRSA-positive, particularly if they are dressing wounds, treating surgical patients or dealing with physically vulnerable patients.

To help prevent the spread of MRSA in a healthcare setting:

- Hand cleansing using soap and water, alcohol gel or other hand cleansing solution should be carried out regularly.
- Topical treatments such as chlorhexidine should be applied to the skin of colonised patients.

- Keep the environment as clean and dry as possible.
- Wear gloves when managing wounds. After removing gloves, wash hands with soap and warm water, or use alcohol-based hand sanitiser.
- Carefully dispose of dressings and other materials that come into contact with blood, nasal discharge, urine, or pus from patients infected with MRSA.
- Clean surfaces in examination rooms, with commercial disinfectant or a 1:100 solution of diluted bleach.
- Equipment in regular use, such as blood pressure cuffs, can be a significant source of infection and should be cleansed regularly.
- Nasal carriage is usually transient, in some cases lasting only a matter of hours. Therefore, routine screening of staff for MRSA carriage is not recommended. Local guidelines may vary but there may be merit in screening staff for persistent colonisation (including nasal, throat and groin swabs) as they come on duty or when new cases are identified among ward patients.

Further reading

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