rexresearch.com

Steven WURZBURGER
Magnesium Hydroxide vs MRSA [Methicillin-Resistant Staphylococcus Aureus]

http://www.mrsa30day.com

Shannon Brown found the application of Wurzburger's solution vs MRSA.

Here's his free online booklet (PDF)

Readers' Digest version : Apparently, this form of solubilized MgOH thwarts the lactic acid metabolism upon which MRSA and the like depend.

USP 5891320
Soluble Magnesium Hydroxide

Inventor: WURZBURGER STEPHEN R [US] ; OVERTON JAMES
EC: C01F11/46; C01F5/22; (+5) IPC: C01F11/46; C01F5/22; C02F1/461; (+15)
1999-04-06
Also published as:
US6110379
US5698107
US6254783

Abstract -- A clear solution and a method for preparing the solution which has a pH in the range of from 10 to 13.9 and containing sulfate ions in a concentration range less than 500 parts per million. The solution is prepared by mixing two solutions in which one solution has one equivalent of **magnesium sulfate** and an equivalent of **sulfuric acid** and the second solution has an equivalent of **Ca (OH)2** and two equivalents of **K2OH**. It is believed that CaSO4 precipitates in the mixed solution and causes coprecipitation of potassium, perhaps as double salt with the Ca leaving OH stabilized by hydration and magnesium ions.

Description

FIELD OF THE INVENTION

This invention relates to methods of making aqueous magnesium hydroxide solutions and particularly to a solution that is clear of the magnesia sludge that characterizes typical industrial aqueous magnesia solutions.

PRIOR ART AND INFORMATION DISCLOSURE

Standard magnesium hydroxide is manufactured by crushing an ore containing magnesium carbonate and calcium carbonate and putting the ore through a kiln in order to drive off CO2 leaving magnesium oxide (MgO) and calcium oxide (CaO).

Numerous chemical processes include steps that require strong base solutions with a high pH. Such processes include, for example, paint stripping operations where it is desirable to loosen and remove an old coating on a steel or cast iron surface down to the bare metal in order to repaint or replate the metal surface. Another group of processes relates to the cleaning of an aluminum surface in which it is required to remove aluminum oxide scale as an initial step in the typical anodizing or alodining process. Extreme care must sometimes be taken in these preliminary steps to prevent etching of the base metal (aluminum) that can damage the metal part.

Generally, solutions including sodium hydroxide (caustic solutions) are used for these operations. The use of sodium hydroxide has the advantage that the salt is very highly soluble and is the agent for obtaining the very high pH necessary to support the desired reaction with the coatings. Usually inhibitors are added to the caustic solution which coat the metal as soon as the offending coating of paint or oxide has been removed. The inhibitors protect the newly exposed surface from further attack by the caustic solution. However, the inhibiting agent, itself can become a problem since it must be removed from the virgin metal surface.

The use of sodium hydroxide in these processes has the advantages that the salt is very highly soluble and provides the means for obtaining the very high pH necessary to support the desired reaction with the coatings and/or underlying oxides. However, an important problem associated with using caustic solutions is the difficulty in removing the sodium ion from the spent (waste) solution. The only practical approach is by major dilution. The presence of sodium in drinking water is not desirable because its presence raises blood pressure.

Attempts have been made to substitute oxide compounds of calcium or magnesium for sodium in order to overcome the problems with sodium. However, such substitutions have not been successful because of the strong tendency of oxide compounds of magnesium and calcium to precipitate and form sludges. Removal of such sludges and the following step of dewatering the sludge has proven to be too expensive for practical application. Furthermore, the pH at which such objectionable precipitation occurs is generally in the range of 9.0 to 10.0 which is appreciably lower than can be obtained with the caustic solutions or is actually required to precipitate and remove heavy metal constituents to a level that is acceptable according to present standards.

SUMMARY

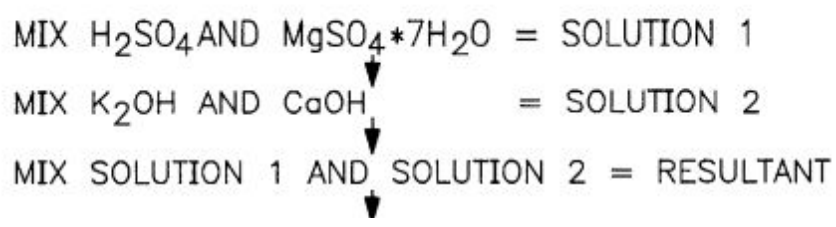
In view of the these difficulties, it is an object of this invention to produce a basic solution in a range between pH=10 to pH=13.9 whose cation is primarily magnesium and which does not form a sludge upon standing.

It is a further object that the basic solution of this invention be non-reactive with human tissue and is much safer to handle than compounds containing Na and K intended for the same applications.

It is another object that the solution be inexpensive to produce and require no special equipment and that waste solutions of the invention be neutralized by electrical chemical processes rather than by the addition of acid neutralizing agents.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 shows a flow chart for producing high pH solutions of magnesia.



FILTER RESULTANT SOLUTION

FIG. 1

FIG. 2 shows shows an apparatus for removing magnesium ions.

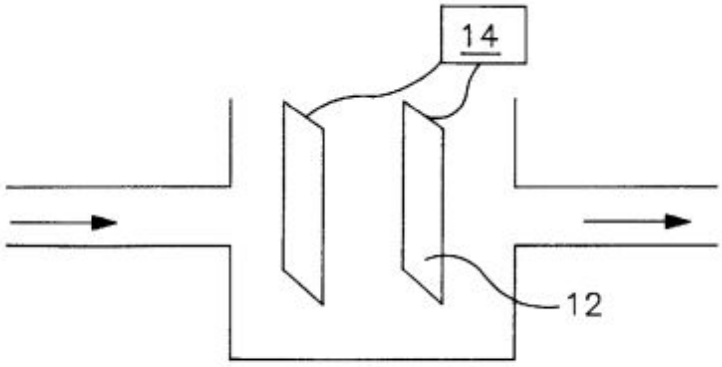


FIG. 2

FIG. 3 shows the steps for using the solution in a process requiring high pH.

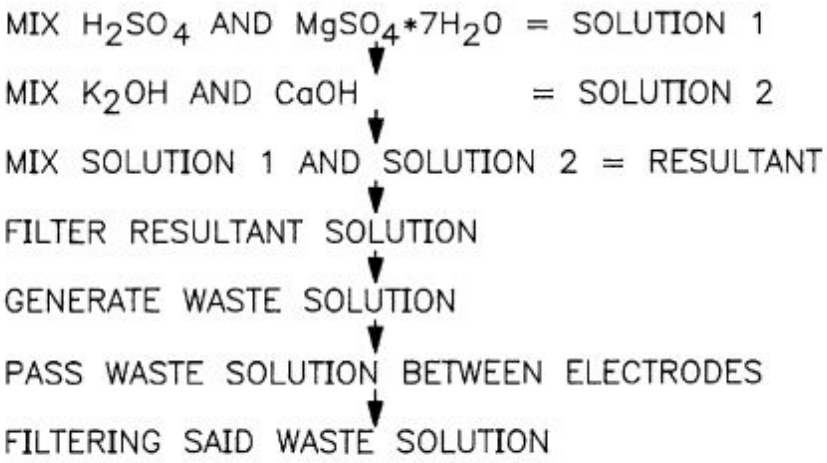


FIG. 3

DESCRIPTION OF A BEST MODE

Turning now to a discussion of the drawings, FIG. 1 is a flow chart showing steps for producing the high pH magnesia solution of this invention.

In step 1, a first solution was formed by adding concentrated sulfuric acid containing one gram atomic weight of H2 SO4 and one gram atomic weight of Mg SO4.7H2 O to two liters of deionized water and agitating so that the resulting MgSO4 is completely dissolved after 30 mins. of mild agitation.

In step 2 a second solution was formed by completely dissolving one gram atomic weight of Ca(OH)2 and two grams atomic weight of K(OH) in two liters of deionized water and agitating for 30 mins.

In step 3, the first and second solutions were mixed together causing a precipitate to form.

In step 4, the solution was filtered through an 11 micron filter thereby producing a filtrate that is the solution of this invention.

The pH of the filtrate was measured and observed to be 13.7. The filtrate was examined in a spectrometer and found to contain 54 parts per million of Ca@++, less than 500 parts per million of SO4@++. Any concentration of K@+ in the first-rate was below the limit of detection by the spectrometer.

By performing the steps in accordance with the method of the invention, a solution containing Mg@++ was formed stabilized by the presence of OH@-- such that the solution has a pH of about 13.7. Appropriate dilution of this solution can be used to reduce the solution to any value in the range from 7@+ to at least 13.7.

In order to compare these results with what would normally be the most direct method of producing an aqueous solution of magnesium hydroxide, the following procedures were performed.

Procedure 1--100.0 grams of Premier Chemical Brucite 200 (MgO*H2 O) was added to 750 ml of deionized water, stirred for two hours, then allowed to set overnight. The solution was then filtered. The precipitate weighed 100.0 gms. indicating that most all of the MgO*H2 O originally mixed into the water had settled out. The pH of the filtrate was 9.45.

Procedure 2 -- To 750 ml of water was added conc. H2 SO4 such as to lower the pH to 3.0. To this sample was added 100.0 gms. of Brucite and mixed and allowed to stand overnight. The solution was filtered and the filtrate was dried. The filtrate was weighed and found to weigh 99.6 gms indicating that 0.4% of the original Brucite had dissolved.

Procedure 3.-- To 750 ml of water was added conc. NaOH such as to raise the pH to 11.0. To this solution was added 100.0 gms. of Brucite, mixed and allowed to stand overnight. The solution was filtered and the filtrate dried and weighed. The filtrate was weighed and it was found that only 0.15% of the original magnesium compound had dissolved. The end pH was found to be 10.1, lower than the initial 11.0 of the NaOH solution in water.

Procedures 1, 2 and 3 demonstrate the difficulty in dissolving magnesium oxide compounds in water such as to obtain a clear solution with a pH greater than 9-10.

Although we do not wish to be bound by theory, it is believed that the results presented above are in accordance with the following discussion.

Magnesium Oxide is known to form a true hydroxide Mg(OH)2 which is very soluble in water, and/or a hydrate, MgO*H2 O which is relatively insoluble. Under the conditions prevailing in procedures 1, 2 and 3, which are general conditions that typify many industrial processes, insoluble MgO*H2 O is the dominant species of magnesium hydroxde when the pH of the solution exceeds 10.0. so that additional amounts of added MgO simply result in forming MgO*H2 O precipitate without further raising the pH.

Under the conditions prevailing according to step 2 of the invention, the hydrated hydroxide ions are formed and remain after the steps of adding the dissolved KOH and Ca(OH)2 to the solution of H2 SO4 and MgSO4. CaSO4 is insoluble in water and KSO4 is soluble in water only to the extent of 10 gms/100 ml water. However, it is also known that potassium forms double sulfate salts with alkali earth metals and so it is reasoned that any K@+ that would otherwise remain in solution will coprecipitate with the precipitated CaSO4, thereby explaining the absence of K@+ in the solution of this invention.

A major advantage for using the solution of this invention compared to state of the art processes using caustic solution to neutralize waste acid solutions is the ability to remove the magnesium ions from waste solutions using electrochemical means which is a method of this invention. FIG. 2 shows an apparatus for removing the magnesium ion. There is shown a pair of iron anodes 12 between which the spent solution

containing magnesium ions is passed. A voltage from power supply 14 is applied between the electrodes in the range 79 to 83 volts. This step causes a precipitate of Mg(OH)3 to form which is filtered out of the solution.

FIG. 3 lists the steps included in a typical process for applying the principles of this invention to situations where the magnesium containing solution is used such as in the neutralization of waste acid solutions or in cleaning operations whereafter the magnesium is removed.

In step 1, a first solution was formed by adding concentrated sulfuric acid containing one gram atomic weight of H2 SO4 and one gram atomic weight of Mg SO4.7H2 O to two liters of deionized water and agitating so that that the resulting MgSO4 is completely dissolved after 30 mins. of mild agitation.

In step 2 a second solution was formed by completely dissolving one gram atomic weight of Ca(OH)2 and two grams atomic weight of K(OH) in two liters of deionized water and agitating for 30 mins.

In step 3, the first and second solutions are mixed together causing a precipitate to form.

In step 4, the solution was filtered through an 11 micron filter thereby producing the a filtrate that is the solution of this invention.

In step 5, the solution from step 4 is used in the intended operation which is typically a metal cleaning operation or acid neutralizing operation.

In step 6 the solution is passed between electrodes with a voltage in the range between 79 to 83 volts providing that magnesium precipitate forms and removing the magnesium ions from solution.

In step 7, the precipitate is filtered out of the solution.

Other concentrations of H2 SO4, Ca(OH)2, KOH, and Mg SO4 have been investigated in the course of reducing this invention to practice which have produced solutions with characteristics similar to the above example and the use of this range of compositions is within the scope of the invention. These ranges are one quarter to three quarter gram atomic weight of H2 SO4, Ca(OH)2, MgSO4 and one half to one gram atomic weight of K(OH) in a liter of water.

However, it is presently believed that the conditions listed in steps 1-4 are optimum for many situations.

The foregoing discussion discloses an example of the application of principles of the invention to produce a solution having a high pH and a heavy concentraion of magnesium ions. The solution is useful in processes such as cleaning or neutralization where it is desired to avoid the formation of sludge and be amenable to post treatment utilizing electrochemical techniques. The principles of the invention include adding a solution of a soluble salt of magnesium (MgSO4) dissolved in an acid having an anion common with the salt to a solution of a strong base (KOH) and a base (Ca(OH)2) in which the cation (Ca@++) and the anion of the soluble salt (SO4@--) precipitate out of soltuion and pull the cation (K@+) of the strong base (KOH) out of solution by coprecipitation leaving, in solution, hydrated (stabilized) hydroxyl ions (OH)*(H2 O)n and Mg@++. Application of these principles thereby provides a solution having a much greater concentration of Mg@++ and a greater pH than has been disclosed by other related processes of the prior art. Other elements can be substituted in the process of this invention to which the same considerations can apply. For example, Barium ions form insoluble precipitates with the sulfate ion and could be a useful substitute for Calcium in some applications.

Other variations of the invention may be suggested after reading the specification that are within the scope of the invention. We therefore wish to define the scope of our invention by the appended claims.

http://en.wikipedia.org/wiki/MRSA

Signs and symptoms

S. aureus most commonly colonizes the anterior nares (the nostrils), although the rest of the respiratory tract, opened wounds, intravenous catheters, and urinary tract are also potential sites for infection. Healthy individuals may carry MRSA asymptomatically for periods ranging from a few weeks to many years. Patients with compromised immune systems are at a significantly greater risk of symptomatic secondary infection.

MRSA can be detected by swabbing most of the nostrils of patients and isolating the bacteria found inside. Combined with extra sanitary measures for those in contact with infected patients, screening patients admitted to hospitals has been found to be effective in minimizing the spread of MRSA in hospitals in the United States,[1] Denmark, Finland, and the Netherlands.[2]

MRSA may progress substantially within 24–48 hours of initial topical symptoms. After 72 hours MRSA can take hold in human tissues and eventually become resistant to treatment. The initial presentation of MRSA is small red bumps that resemble pimples, spider bites, or boils that may be accompanied by fever and occasionally rashes. Within a few days the bumps become larger, more painful, and eventually open into deep, pus-filled boils.[3] About 75 percent of community-associated (CA-) MRSA infections are localized to skin and soft tissue and usually can be treated effectively. However, some CA-MRSA strains display enhanced virulence, spreading more rapidly and causing illness much more severe than traditional healthcare-associated (HA-) MRSA infections, and they can affect vital organs and lead to widespread infection (sepsis), toxic shock syndrome and necrotizing ("flesh-eating") pneumonia. This is thought to be due to toxins carried by CA-MRSA strains, such as PVL and PSM, though PVL was recently found to not be a factor in a study by the National Institute of Allergy and Infectious Diseases (NIAID) at the NIH. It is not known why some healthy people develop CA-MRSA skin infections that are treatable whereas others infected with the same strain develop severe infections or die.[4] The bacteria attack parts of the immune system, and even engulf white blood cells, the opposite of the usual.[4]

The most common manifestations of CA-MRSA are skin infections such as necrotizing fasciitis or pyomyositis (most commonly found in the tropics), necrotizing pneumonia, infective endocarditis (which affects the valves of the heart), or bone or joint infections.[5] CA-MRSA often results in abscess formation that requires incision and drainage. Before the spread of MRSA into the community, abscesses were not considered contagious because it was assumed that infection required violation of skin integrity and the introduction of staphylococci from normal skin colonization. However, newly emerging CA-MRSA is transmissible (similar, but with very important differences) from Hospital-Associated MRSA. CA-MRSA is less likely than other forms of MRSA to cause cellulitis.
[edit] Risk factors

At risk populations include:

People with weak immune systems (people living with HIV/AIDS, cancer patients, transplant recipients, severe asthmatics, etc.)
Diabetics
Intravenous drug users
Use of quinolone antibiotics[6]
Young children
The elderly
College students living in dormitories
People staying or working in a health care facility for an extended period of time
People who spend time in coastal waters where MRSA is present, such as some beaches in Florida and the west coast of the United States[7][8]
People who spend time in confined spaces with other people, including prison inmates, soldiers in basic training,[9] and individuals who spend considerable time in changerooms or gyms.
Hospital patients

Prison inmates
People in contact with live food-producing animals

Diagnosis

Diagnostic microbiology laboratories and reference laboratories are key for identifying outbreaks of MRSA. New rapid techniques for the identification and characterization of MRSA have been developed. This notwithstanding, the bacterium generally must be cultured via blood, urine, sputum, or other body fluid cultures, and grown up in the lab in sufficient numbers to perform these confirmatory tests first, so there is no quick and easy method to diagnose an MRSA infection, therefore initial treatment is often based upon 'strong suspicion' by the treating physician, since any delay in treating this type of infection can have fatal consequences. These techniques include Real-time PCR and Quantitative PCR and are increasingly being employed in clinical laboratories for the rapid detection and identification of MRSA strains.[19][20]

Another common laboratory test is a rapid latex agglutination test that detects the PBP2a protein. PBP2a is a variant penicillin-binding protein that imparts the ability of S. aureus to be resistant to oxacillin.[21]

Strains

In the UK, where MRSA is commonly called "Golden Staph", the most common strains of MRSA are EMRSA15 and EMRSA16.[22] EMRSA16 is the best described epidemiologically: it originated in Kettering, England, and the full genomic sequence of this strain has been published.[23] EMRSA16 has been found to be identical to the ST36:USA200 strain, which circulates in the United States, and to carry the SCCmec type II, enterotoxin A and toxic shock syndrome toxin 1 genes.[24] Under the new international typing system, this strain is now called MRSA252. It is not entirely certain why this strain has become so successful, whereas previous strains have failed to persist. One explanation is the characteristic pattern of antibiotic susceptibility. Both the EMRSA15 and EMRSA16 strains are resistant to erythromycin and ciprofloxacin. It is known that Staphylococcus aureus can survive intracellularly,[25] for example in the nasal mucosa [26] and in the tonsil tissue ,.[27] Erythromycin and Ciprofloxacin are precisely the antibiotics that best penetrate intracellularly; it may be that these strains of S. aureus are therefore able to exploit an intracellular niche.

Community-acquired MRSA (CA-MRSA) is more easily treated, though more virulent, than hospital-acquired MRSA (HA-MRSA). CA-MRSA apparently did not evolve de novo in the community but represents a hybrid between MRSA that spread from the hospital environment and strains that were once easily treatable in the community. Most of the hybrid strains also acquired a factor that increases their virulence, resulting in the development of deep-tissue infections from minor scrapes and cuts, as well as many cases of fatal pneumonia.[28]

In the United States, most cases of CA-MRSA are caused by a CC8 strain designated ST8:USA300, which carries SCCmec type IV, Panton-Valentine leukocidin, PSM-alpha and enterotoxins Q and K,[24] and ST1:USA400.[29] Other community-acquired strains of MRSA are ST8:USA500 and ST59:USA1000. In many nations of the world, MRSA strains with different predominant genetic background types have come to predominate among CA-MRSA strains; USA300 easily tops the list in the U. S. and is becoming more common in Canada after its first appearance there in 2004. For example, in Australia ST93 strains are common, while in continental Europe ST80 strains predominate (Tristan et al., Emerging Infectious Diseases, 2006). In Taiwan, ST59 strains, some of which are resistant to many non-beta-lactam antibiotics, have arisen as common causes of skin and soft tissue infections in the community. In a remote region of Alaska, unlike most of the continental U. S., USA300 was found rarely in a study of MRSA strains from outbreaks in 1996 and 2000 as well as in surveillance from 2004–06 (David et al., Emerg Infect Dis 2008).

Surface sanitizing

NAV-CO2 sanitizing in Pennsylvania hospital exam room

Alcohol has been proven to be an effective surface sanitizer against MRSA. Quaternary ammonium can be used in conjunction with alcohol to extend the longevity of the sanitizing action.[37] The prevention of nosocomial infections involves routine and terminal cleaning. Non-flammable Alcohol Vapor in Carbon Dioxide systems (NAV-CO2) do not corrode metals or plastics used in medical environments and do not contribute to antibacterial resistance.

In healthcare environments, MRSA can survive on surfaces and fabrics, including privacy curtains or garments worn by care providers. Complete surface sanitation is necessary to eliminate MRSA in areas where patients are recovering from invasive procedures. Testing patients for MRSA upon admission, isolating MRSA-positive patients, decolonization of MRSA-positive patients, and terminal cleaning of patients' rooms and all other clinical areas they occupy is the current best practice protocol for nosocomial MRSA.

Hand washing

At the end of August 2004, after a successful pilot scheme to tackle MRSA, the UK National Health Service announced its Clean Your Hands campaign. Wards were required to ensure that alcohol-based hand rubs are placed near all beds so that staff can hand wash more regularly. It is thought that even if this cuts infection by no more than 1%, the plan will pay for itself many times over.[citation needed]

As with some other bacteria, MRSA is acquiring more resistance to some disinfectants and antiseptics. Although alcohol-based rubs remain somewhat effective, a more effective strategy is to wash hands with running water and an anti-microbial cleanser with persistent killing action, such as Chlorhexidine[38]

A June 2008 report[citation needed], centered on a survey by the Association for Professionals in Infection Control and Epidemiology, concluded that poor hygiene habits remain the principal barrier to significant reductions in the spread of MRSA.

Essential oil diffusion

An in vitro study on the inhibition of MRSA by essential oil diffusion found that 72 of 91 investigated essential oils exhibited zones of inhibition in soy agar plates streaked with MRSA (strain ATCC 700699). The most effective being lemongrass oil (Cymbopogon flexuosus), lemon myrtle oil (Backhousia citriodora), mountain savory oil (Satureja montana), cinnamon oil (Cinnamomum verum), and melissa oil (Melissa officinalis) essential oils. Of these, lemongrass essential oil was the most effective, completely inhibiting all MRSA colony growth.[39]

Tea tree oil also kills all MRSA strains that have been tested.[40]

Decolonization

After the drainage of boils or other treatment for MRSA, patients can shower at home using chlorhexidine (Hibiclens) or hexachlorophene (Phisohex) antiseptic soap from head to toe, and apply mupirocin (Bactroban) 2% ointment inside each nostril twice daily for 7 days, using a cotton-tipped swab. Household members are recommended to follow the same decolonization protocol.

Doctors may also prescribe antibiotics such as clindamycin, doxycycline or trimethoprim/sulfamethoxazole. However, there is very little evidence that using more antibiotics actually has the effect of preventing recurrent MRSA skin infections.[41]

Proper disposal of hospital gowns

Used paper hospital gowns are associated with MRSA hospital infections, which could be avoided by proper disposal.[42]

Isolation

Current US guidance does not require workers in the general workplace (excluding medical facilities) with MRSA infections to be routinely excluded from going to work.[43] Therefore, unless directed by a health care provider, exclusion from work should be reserved for those with wound drainage that cannot be covered and contained with a clean, dry bandage and for those who cannot maintain good hygiene practices.[43] Workers with active infections should be excluded from activities where skin-to-skin contact is likely to occur until their infections are healed. Health care workers should follow the Centers for Disease Control and Prevention's Guidelines for Infection Control in Health Care Personnel.[44]

To prevent the spread of staph or MRSA in the workplace, employers should ensure the availability of adequate facilities and supplies that encourage workers to practice good hygiene; that surface sanitizing in the workplace is followed; and that contaminated equipment are sanitized with Environmental Protection Agency (EPA)-registered disinfectants.[43]

Restricting antibiotic use

Glycopeptides, cephalosporins and in particular quinolones are associated with an increased risk of colonisation of MRSA. Reducing use of antibiotic classes that promote MRSA colonisation, especially fluoroquinolones, is recommended in current guidelines.[6][10]

Treatment

Both CA-MRSA and HA-MRSA are resistant to traditional anti-staphylococcal beta-lactam antibiotics, such as cephalexin. CA-MRSA has a greater spectrum of antimicrobial susceptibility, including to sulfa drugs (like co-trimoxazole/trimethoprim-sulfamethoxazole), tetracyclines (like doxycycline and minocycline) and clindamycin, but the drug of choice for treating CA-MRSA has is now believed to be Vancomycin, according to a Henry Ford Hospital Study. The study was presented on October 23, 2010, at the 48th annual meeting of the Infectious Diseases Society of America in Vancouver. HA-MRSA is resistant even to these antibiotics and often is susceptible only to vancomycin. Newer drugs, such as linezolid (belonging to the newer oxazolidinones class) and daptomycin, are effective against both CA-MRSA and HA-MRSA.

Vancomycin and teicoplanin are glycopeptide antibiotics used to treat MRSA infections.[54] Teicoplanin is a structural congener of vancomycin that has a similar activity spectrum but a longer half-life.[55] Because the oral absorption of vancomycin and Teicoplanin is very low, these agents must be administered intravenously to control systemic infections.[56] Drugs are administered via a Peripherally inserted central catheter, or a Picc Line, which is inserted by radiologists, doctors, physician assistants (in the U.S.), radiologist assistants (in the U.S.), or specially trained certified registered nurses.[57] Treatment of MRSA infection with vancomycin can be complicated, due to its inconvenient route of administration. Moreover, many clinicians believe that the efficacy of vancomycin against MRSA is inferior to that of anti-staphylococcal beta-lactam antibiotics against MSSA.[58][59]

Several newly discovered strains of MRSA show antibiotic resistance even to vancomycin and teicoplanin. These new evolutions of the MRSA bacterium have been dubbed Vancomycin intermediate-resistant Staphylococcus aureus (VISA).[60] [61] Linezolid, quinupristin/dalfopristin(synercid), daptomycin, and tigecycline are used to treat more severe infections that do not respond to glycopeptides such as vancomycin.[62]

There have been claims that bacteriophage can be used to cure MRSA. [63]

The psychedelic mushroom **Psilocybe semilanceata** has been shown to strongly inhibit the growth of Staphylococcus aureus.[citation needed]

Initial studies at the University of East London have demonstrated that **allicin** (a compound found in garlic) exhibits a strong antimicrobial response to the bacteria, indicating that it may one day lead to more effective treatments.[64]

Research

Clinical

It has been reported that maggot therapy to clean out necrotic tissue of MRSA infection has been successful. Studies in diabetic patients reported significantly shorter treatment times than those achieved with standard treatments.[78][79][80]

Many antibiotics against MRSA are in phase II and phase III clinical trials. eg:

* Phase III : ceftobiprole, Ceftaroline, Dalbavancin, Telavancin, Aurograb, torezolid, iclaprim...
* Phase II : nemonoxacin.[81]

Pre-clinical

An entirely different and promising approach is phage therapy (e.g., at the Eliava Institute in Georgia[82]), which in mice had a reported efficacy against up to 95% of tested Staphylococcus isolates. [83]

On May 18, 2006, a report in Nature identified a new antibiotic, called platensimycin, that had demonstrated successful use against MRSA.[84][85]

Ocean-dwelling living sponges produce compounds that may make MRSA more susceptible to antibiotics.[86]

Cannabinoids (components of Cannabis sativa), including cannabidiol (CBD), cannabinol (CBN), cannabichromene (CBC) and cannabigerol (CBG), show activity against a variety of MRSA strains. [87]

References

1. ^ Study at the Veterans Affairs hospital in Pittsburgh: "Science Daily". http://www.sciencedaily.com/upi/index.php?feed=Science&article=UPI-1-20070727-15235200-bc-us-infections.xml. [dead link]
2. ^ McCaughey B. "Unnecessary Deaths: The Human and Financial Costs of Hospital Infections" (PDF). Archived from the original on July 11, 2007. http://web.archive.org/web/20070711030535/http://www.tufts.edu/med/apua/Patients/ridbooklet.pdf. Retrieved 2007-08-05.
3. ^ "Symptoms". Mayo Clinic. http://www.mayoclinic.com/health/mrsa/DS00735/DSECTION=symptoms.
4. ^ a b "MRSA Toxin Acquitted: Study Clears Suspected Key to Severe Bacterial Illness". NIH news release. National Institute of Health. 2006-11-06. http://www3.niaid.nih.gov/news/newsreleases/2006/staphtoxin.htm.
5. ^ a b c Raygada JL and Levine DP (March 30, 2009). "Managing CA-MRSA Infections: Current and Emerging Options". Infections in Medicine 26 (2). http://www.consultantlive.com/infection/article/1145625/1393856.
6. ^ a b c Tacconelli, E.; De Angelis, G.; Cataldo, MA.; Pozzi, E.; Cauda, R. (Jan 2008). "Does antibiotic exposure increase the risk of methicillin-resistant Staphylococcus aureus (MRSA) isolation? A systematic review and meta-analysis.". J Antimicrob Chemother 61 (1): 26–38. doi:10.1093/jac/dkm416. PMID 17986491. http://jac.oxfordjournals.org/cgi/content/full/61/1/26.
7. ^ Reuters (2009-02-16). "Study: Beachgoers More Likely to Catch MRSA". FoxNews.com. http://www.foxnews.com/story/0,2933,493604,00.html.
8. ^ Marilynn Marchione (2009-09-12). "Dangerous staph germs found at West Coast beaches". AP. http://www.foxnews.com/story/0,2933,549601,00.html.
9. ^ Zinderman, C.; Conner, B.; Malakooti, M.; LaMar, J.; Armstrong, A.; Bohnker, A. (May 2004). "Community-Acquired Methicillin-Resistant Staphylococcus aureus Among Military Recruits". Emerging Infectious Diseases. http://www.medscape.com/viewarticle/474843.

10. ^ a b Muto, CA.; Jernigan, JA.; Ostrowsky, BE.; Richet, HM.; Jarvis, WR.; Boyce, JM.; Farr, BM. (May 2003). "SHEA guideline for preventing nosocomial transmission of multidrug-resistant strains of Staphylococcus aureus and enterococcus.". Infect Control Hosp Epidemiol 24 (5): 362–86. doi:10.1086/502213. PMID 12785411.
11. ^ Staph (MRSA) Infection Eradicated For 14 Months
12. ^ "Joint scientific report of ECDC, EFSA and EMEA on meticillin resistant Staphylococcus aureus (MRSA) in livestock, companion animals and food". 2009-06-16. http://www.efsa.europa.eu/EFSA/Report/biohaz_report_301_joint_mrsa_en,0.pdf. Retrieved 2009-09-19.
13. ^ "New England Journal of Medicine". http://content.nejm.org/cgi/content/full/352/5/468.
14. ^ Epstein, Victor (21 December 2007). "Texas Football Succumbs to Virulent Staph Infection From Turf". Bloomberg. http://www.bloomberg.com/apps/news?pid=newsarchive&sid=alxhrJDn.cdc. Retrieved 10 June 2010.
15. ^ "SVSD410". http://svsd410.org/districtinfo/newspubs/news.asp?DistrictNewsID=262. [dead link]
16. ^ MRSA: the problem reaches paediatrics — Archives of Disease in Childhood
17. ^ Community-associated Methicillin-resistant Staphylococcus aureus in Hospital Nursery and Maternity Units — CDC
18. ^ Association for Professionals in Infection Control & Epidemiology (June 25, 2007). "National Prevalence Study of Methicillin-Resistant Staphylococcus aureus (MRSA) in U.S. Healthcare Facilities". Archived from the original on September 7, 2007. http://web.archive.org/web/20070907201425/http://www.apic.org/Content/NavigationMenu/ResearchFoun Retrieved 2007-07-14.
19. ^ Francois P and Schrenzel J (2008). "Rapid Diagnosis and Typing of Staphylococcus aureus". Staphylococcus: Molecular Genetics. Caister Academic Press. ISBN 9781904455295. http://www.horizonpress.com/staph.
20. ^ Mackay I M (editor). (2007). Real-Time PCR in Microbiology: From Diagnosis to Characterization. Caister Academic Press. ISBN 9781904455189. http://www.horizonpress.com/rtmic.
21. ^ Seiken, Denka. "MRSA latex test for PBP2". http://www.hardydiagnostics.com/catalog2/hugo/MRSALatexTest.htm.
22. ^ Johnson AP, Aucken HM, Cavendish S, et al. (2001). "Dominance of EMRSA-15 and -16 among MRSA causing nosocomial bacteraemia in the UK: analysis of isolates from the European Antimicrobial Resistance Surveillance System (EARSS)". J Antimicrob Chemother 48 (1): 143–4. doi:10.1093/jac/48.1.143. PMID 11418528. http://jac.oxfordjournals.org/cgi/content/full/48/1/143.
23. ^ Holden MTG, Feil EJ, Lindsay JA, et al. (2004). "Complete genomes of two clinical Staphylococcus aureus strains: Evidence for the rapid evolution of virulence and drug resistance". Proc Natl Acad Sci USA 101 (26): 9786–91. doi:10.1073/pnas.0402521101. PMID 15213324.
24. ^ a b Diep B, Carleton H, Chang R, Sensabaugh G, Perdreau-Remington F (2006). "Roles of 34 virulence genes in the evolution of hospital- and community-associated strains of methicillin-resistant Staphylococcus aureus". J Infect Dis 193 (11): 1495–503. doi:10.1086/503777. PMID 16652276.
25. ^ von Eiff C, Becker K, Metze D, et al. (2001). "Intracellular persistence of Staphylococcus aureus small-colony variants within keratinocytes: a cause for antibiotic treatment failure in a patient with Darier's disease". Clin Infect Dis 32 (11): 1643–7. doi:10.1086/320519. PMID 11340539.
26. ^ Clement S, Vaudaux P, François P, et al. (2005). "Evidence of an intracellular reservoir in the nasal mucosa of patients with recurrent Staphylococcus aureus rhinosinusitis". J Infect Dis 192 (6): 1023–8. doi:10.1086/432735. PMID 16107955.
27. ^ Zautner AE, Krause M, Stropahl G, et al. (2010). "Intracellular persisting Staphylococcus aureus is the major pathogen in recurrent tonsillitis". PloS One 5 (3): e9452. doi:10.1371/journal.pone.0009452. PMID 20209109.
28. ^ "Community-Associated meticillin-resistant Staphylococcusaureus: an emerging threat" (PDF). The Lancet. http://coe.ed.uidaho.edu/uploads/9/documents/MRSA%20review%207-05.pdf.
29. ^ R Wang et al. "Identification of novel cytolytic peptides as key virulence determinants of community-associated MRSA". Nature Medicine DOI: 10.1038/nm1656 (2007).
30. ^ Tacconelli E, De Angelis G, de Waure C, et al. (2009). "Rapid screening tests for meticillin-resistant Staphylococcus aureus at hospital admission: systematic review and meta-analysis". Lancet Infect Dis 9 (9): 546–554. doi:10.1016/S1473-3099(09)70150-1.
31. ^ "To Catch a Deadly Germ," New York Times opinion
32. ^ CDC Guideline "Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006"

33. ^ http://www.halifaxcourier.co.uk/latest-york-and-humberside-news/New-checks-in-hospitals-to.5123093.jp
34. ^ "MRSA test for surgical patients". BBC News. 2009-03-31. http://news.bbc.co.uk/1/hi/health/7974964.stm. Retrieved 2010-04-05.
35. ^ http://www.mrsatest.co.uk
36. ^ Fritz SA, Garbutt J, Elward A, et al. (2008). "Prevalence of and risk factors for community-acquired methicillin-resistant and methicillin-sensitive Staphylococcus aureus colonization in children seen in a practice-based research network". Pediatrics 121 (6): 1090–1098. doi:10.1542/peds.2007-2104. PMID 18519477.
37. ^ Angela L. Hollingsworth. "AOAC Use Dilution Test Health Care" (PDF). http://www.sanisys.com/pdf_epa_salmo.pdf. Retrieved 2003-09-26.
38. ^ Demarco, E.; Cushing, A.; Frempong-Manso, E.; Seo, M.; Jaravaza, A.; Kaatz, W. (Sep 2007). "Efflux-Related Resistance to Norfloxacin, Dyes, and Biocides in Bloodstream Isolates of Staphylococcus aureus" (Free full text). Antimicrobial Agents and Chemotherapy 51 (9): 3235. doi:10.1128/AAC.00430-07. ISSN 0066-4804. PMID 17576828. PMC 2043220. http://aac.asm.org/cgi/pmidlookup?view=long&pmid=17576828. edit
39. ^ Inhibition of methicillin-resistant Stapphulococcus aureus (MRSA) by essential oils; Sue Chao, Gary Young, Craig Oberg, and Karen Nakaoka; Flavour and Fragrance Journal, 2008; 23: 444–449
40. ^ Susceptibility of methicillin-resistant Staphylococcus aureus to the essential oil of Melaleuca alternifolia
41. ^ Buckingham, SC (December 2008). "Prevention of Recurrent MRSA Skin Infections: What You Need to Know". Consultant 48 (13). http://www.consultantlive.com/display/article/10162/1360561.
42. ^ "Simple techniques slash hospital infections: meeting". Reuters. 2009-03-21. http://www.reuters.com/article/healthNews/idUSTRE52K1O920090321.
43. ^ a b c "NIOSH MRSA and the Workplace". United States National Institute for Occupational Safety and Health. http://www.cdc.gov/niosh/topics/mrsa/. Retrieved 2007-10-29.
44. ^ CDC (1998). "Guidelines for Infection Control in Health Care Personnel, 1998". Centers for Disease Control and Prevention. http://www.cdc.gov/ncidod/dhqp/gl_hcpersonnel.html. Retrieved December 18, 2007.
45. ^ Cooper BS, Medley GF, Stone SP, et al. (2004). "Methicillin-resistant Staphylococcus aureus in hospitals and the community: stealth dynamics and control catastrophes". Proceedings of the National Academy of Sciences 101 (27): 10223–8. doi:10.1073/pnas.0401324101. PMID 15220470.
46. ^ Bootsma MC, Diekmann O, Bonten MJ (2006). "Controlling methicillin-resistant Staphylococcus aureus: quantifying the effects of interventions and rapid diagnostic testing". Proc Natl Acad Sci USA 103 (14): 5620–5. doi:10.1073/pnas.0510077103. PMID 16565219.
47. ^ Johnson AP, Pearson A, Duckworth G (2005). "Surveillance and epidemiology of MRSA bacteraemia in the UK". J Antimicrob Chemother 56 (3): 455–62. doi:10.1093/jac/dki266. PMID 16046464.
48. ^ Inquirer.net, Cases of RP maids with 'superbug' infection growing in HK
49. ^ "MRSA Infections". Keep Kids Healthy. http://www.keepkidshealthy.com/welcome/infectionsguide/mrsa.html.
50. ^ Graham P, Lin S, Larson E (2006). "A U.S. population-based survey of Staphylococcus aureus colonization". Ann Intern Med 144 (5): 318–25. PMID 16520472.
51. ^ Jernigan JA, Arnold K, Heilpern K, Kainer M, Woods C, Hughes JM (2006-05-12). "Methicillin-resistant Staphylococcus aureus as community pathogen". Symposium on Community-Associated Methicillin-resistant Staphylococcus aureus (Atlanta, Georgia, U.S.). Cited in Emerg Infect Dis. Centers for Disease Control and Prevention. http://www.cdc.gov/ncidod/EID/vol12no11/06-0911.htm. Retrieved 2007-01-27.
52. ^ First study finds MRSA in U.S. pigs and farmers, seattlepi.com, 4 June 2008
53. ^ Our Pigs, Our Food, Our Health, The New York Times, 12 March 2009
54. ^ Schentag JJ, Hyatt JM, Carr JR, Paladino JA, Birmingham MC, Zimmer GS, Cumbo TJ (1998). "Genesis of methicillin-resistant Staphylococcus aureus (MRSA), how treatment of MRSA infections has selected for vancomycin-resistant Enterococcus faecium, and the importance of antibiotic management and infection control". Clin. Infect. Dis. 26 (5): 1204–14. doi:10.1086/520287. PMID 9597254.
55. ^ Rybak MJ, Lerner SA, Levine DP, Albrecht LM, McNeil PL, Thompson GA, Kenny MT, Yuh L (1991). "Teicoplanin pharmacokinetics in intravenous drug abusers being treated for bacterial

endocarditis". Antimicrob. Agents Chemother. 35 (4): 696–700. PMID 1829880.
56. ^ Janknegt R (1997). "The treatment of staphylococcal infections with special reference to pharmacokinetic, pharmacodynamic, and pharmacoeconomic considerations". Pharmacy world & science : PWS 19 (3): 133–41. doi:10.1023/A:1008609718457. PMID 9259029.
57. ^ Kirsten Edwards
58. ^ Chang FY, Peacock JE Jr, Musher DM, et al. (2003). "Staphylococcus aureus bacteremia: recurrence and the impact of antibiotic treatment in a prospective multicenter study.". Medicine (Baltimore) 82 (5): 333–9. doi:10.1097/01.md.0000091184.93122.09. PMID 14530782.
59. ^ Siegman-Igra Y, Reich P, Orni-Wasserlauf R, Schwartz D, Giladi M. (2005). "The role of vancomycin in the persistence or recurrence of Staphylococcus aureus bacteraemia". Scand J Infect Dis 37 (8): 572–8. doi:10.1080/00365540510038488. PMID 16138425.
60. ^ Sieradzki K, Tomasz A (1997). "Inhibition of cell wall turnover and autolysis by vancomycin in a highly vancomycin-resistant mutant of Staphylococcus aureus". J. Bacteriol. 179 (8): 2557–66. PMID 9098053.
61. ^ Schito GC (2006). "The importance of the development of antibiotic resistance in Staphylococcus aureus". Clin Microbiol Infect 12 Suppl 1: 3–8. doi:10.1111/j.1469-0691.2006.01343.x. PMID 16445718. }
62. ^ Mongkolrattanothai K, Boyle S, Kahana MD, Daum RS (2003). "Severe Staphylococcus aureus infections caused by clonally related community-associated methicillin-susceptible and methicillin-resistant isolates". Clin. Infect. Dis. 37 (8): 1050–8. doi:10.1086/378277. PMID 14523769.
63. ^ [1]
64. ^ Cutler R.R. (2004). "Antibacterial activity of a new, stable, aqueous extract of allicin against methicillin-resistant Staphylococcus aureus.". British journal of biomedical science. PMID 15250668. }
65. ^ Klein E, Smith DL, Laxminarayan R (2007). "Hospitalizations and Deaths Caused by Methicillin-Resistant Staphylococcus aureus, United States, 1999–2005". Emerg Infect Dis 13 (12): 1840–6. PMID 18258033.
66. ^ Klevens et al. (2007), "Invasive Methicillin-Resistant Staphylococcus aureus Infections in the United States". JAMA. Retrieved on 2007-10-31.
67. ^ Centers for Disease Control and Prevention (October 17, 2007), "MRSA: Methicillin-resistant Staphylococcus aureus in Healthcare Settings
68. ^ Stein R (October 17, 2007), "Drug-resistant staph germ's toll is higher than thought." Washington Post. Retrieved on 2007-10-19.
69. ^ UK Office for National Statistics Online (February 22, 2007), "MRSA Deaths continue to rise in 2005"
70. ^ Hospitals struck by new killer bug An article by Manchester free newspaper 'Metro', May 7, 2008
71. ^ Blot S, Vandewoude K, Hoste E, Colardyn F (2002). "Outcome and attributable mortality in critically Ill patients with bacteremia involving methicillin-susceptible and methicillin-resistant Staphylococcus aureus". Arch Intern Med 162 (19): 2229–35. doi:10.1001/archinte.162.19.2229. PMID 12390067.
72. ^ Liu et al., A population-based study of the incidence and molecular epidemiology of methicillin-resistant Staphylococcus aureus disease in San Francisco, 2004–2005. Clin Infect Dis. 2008 Jun 1;46(11):1637–46)
73. ^ Noskin GA, Rubin RJ, Schentag JJ, Kluytmans J, Hedblom EC, Smulders M, Lapetina E, Gemmen E (2005). "The Burden of Staphylococcus aureus Infections on Hospitals in the United States: An Analysis of the 2000 and 2001 Nationwide Inpatient Sample Database". Arch Intern Med 165 (15): 1756–1761. doi:10.1001/archinte.165.15.1756. PMID 16087824.
74. ^ Cosgrove SE, Qi Y, Kaye KS, Harbarth S, Karchmer AW, Carmeli Y (2005). "The impact of Methicillin Resistance in Staphylococcus aureus Bacteremia on Patient Outcomes: Mortality, Length of Stay, and Hospital Charges" (– Scholar search). Infection Control and Hospital Epidemiology 26 (2): 166–174. doi:10.1086/502522. PMID 15756888.
http://www.journals.uchicago.edu/ICHE/journal/issues/v26n2/9885/9885.html. [dead link]
75. ^ Hardy KJ, Hawkey PM, Gao F, Oppenheim BA (2004). "Methicillin resistant Staphylococcus aureus in the critically ill". British Journal of Anaesthesia 92 (1): 121–30. doi:10.1093/bja/aeh008. PMID 14665563.
76. ^ Wyllie D, Crook D, Peto T (2006). "Mortality after Staphylococcus aureus bacteraemia in two hospitals in Oxfordshire, 1997–2003: cohort study". BMJ 333 (7562): 281.

doi:10.1136/bmj.38834.421713.2F. PMID 16798756. PMC 1526943.
http://bmj.bmjjournals.com/cgi/content/abstract/333/7562/281.
77. ^ Okuma K, Iwakawa K, Turnidge J, et al. (2002). "Dissemination of new methicillin-resistant Staphylococcus aureus clones in the community". J Clin Microbiol 40 (11): 4289–94. doi:10.1128/JCM.40.11.4289-4294.2002. PMID 12409412.
78. ^ Bowling FL, Salgami EV, Boulton AJ (2007). "Larval therapy: a novel treatment in eliminating methicillin-resistant Staphylococcus aureus from diabetic foot ulcers". Diabetes Care 30 (2): 370–1. doi:10.2337/dc06-2348. PMID 17259512.
79. ^ "Maggots help cure MRSA patients". BBC News. 2007-05-02. http://news.bbc.co.uk/2/hi/uk_news/england/manchester/6614471.stm.
80. ^ "Maggots rid patients of MRSA". EurekAlert!/AAAS. 2007-05-03. http://www.eurekalert.org/pub_releases/2007-05/uom-mrp050307.php.
81. ^ http://clinicaltrials.gov/ct2/show/NCT00685698
82. ^ Murphy, Clare (2007-08-13). "'Red Army' virus to combat MRSA". BBC News. http://news.bbc.co.uk/2/hi/health/6943779.stm.
83. ^ Matsuzaki S, Yasuda M, Nishikawa H, Kuroda M, Ujihara T, Shuin T, Shen Y, Jin Z, Fujimoto S, Nasimuzzaman MD, Wakiguchi H, Sugihara S, Sugiura T, Koda S, Muraoka A, Imai S (2003). "Experimental protection of mice against lethal Staphylococcus aureus infection by novel bacteriophage phi MR11". J. Infect. Dis. 187 (4): 613–24. doi:10.1086/374001. PMID 12599078.
84. ^ Bayston R, Ashraf W, Smith T (2007). "Triclosan resistance in methicillin-resistant Staphylococcus aureus expressed as small colony variants: a novel mode of evasion of susceptibility to antiseptics". J. Antimicrob. Chemother. 59 (5): 848–53. doi:10.1093/jac/dkm031. PMID 17337510.
85. ^ Wang J; Soisson, SM; Young, K; Shoop, W; Kodali, S; Galgoci, A; Painter, R; Parthasarathy, G et al. (May 2006). "Platensimycin is a selective FabF inhibitor with potent antibiotic properties". Nature 441 (441): 358–361. doi:10.1038/nature04784. PMID 16710421.
86. ^ Sponge's secret weapon restores antibiotics' power
87. ^ Appendino G, Gibbons S, Giana A, Pagani A, Grassi G, Stavri M, Smith E, Rahman M (2008). "Antibacterial Cannabinoids from Cannabis sativa: A Structure-Activity Study". J. Nat. Prod. 71 (8): 1427–30. doi:10.1021/np8002673. PMID 18681481