Community-acquired methicillin-resistant *Staphylococcus aureus* (MRSA)

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Abstract

Introduction. The emergence, since 1980, of new community-associated MRSA strains genetically unrelated to earlier nosocomial-associated MRSA since the 1960`s conditioned the reassessment of the treatment of choice for these infections.
These new community-associated MRSA strains are highly virulent, and cause skin and soft tissue infections and necrotizing pneumonia in otherwise healthy adults and children.
Clinical cases. We report 3 cases of community-acquired Staphylococcus aureus. The first one was described in November 2005.
Results: All our patients improved.
Discussion: The staphylococcal infection treatment triangle is not equilateral, but leans in favor of surgical drainage as treatment of choice.
As antibiotic resistance increases, the trend towards treating infections with first-generation cephalosporins, penicillins, and macrolides decreases. Knowledge of the local resistance trends is important in order to make decisions on empiric therapy. The antibiotic resistance pattern should be assessed whenever possible, thus allowing the practitioner to promptly assess the risks and benefits of alternative antibiotics, which may be required for definite therapy.
MRSA community-acquired strains are often susceptible to trimethoprim-sulfamethoxazole, minocycline, or doxycycline, with 10 to 21 days treatment in uncomplicated cases. Although quinolones are often reported to be active in vitro against community-acquired S. aureus, resistance to said antibiotic is common. Mupirocin is frequently used topically, but should be limited to short courses in confirmed cases of S. aureus infections, because chronic use of this antibiotic is associated with a significant increase in resistance (Dermatol Argent 2008;14(5):367-371).

Key words: *methicillin-resistant Staphylococcus aureus, trimethoprim-sulfamethoxazole.*

Introduction

In the last decades, there has been an increasing number of infections caused by community-acquired *Staphylococcus aureus*.[1] This may be associated with a smaller development of new antibiotics (ATB), and with the emergence of resistant strains.
These new community-associated strains are highly virulent, and cause skin and soft tissue infections, in addition to necrotizing pneumonia in otherwise healthy adults and children.[2]
Initially, *S. aureus* was very susceptible to penicillin, but resistant strains emerged by bacterial acquisition of penicillinase. The first penicillinase-resistant beta-lactam antibiotics were developed in 1960, but soon the first resistant strains (R) were described.[3] Historically, infections by methicillin-resistant staphylococci strains were associated to health care, and the bacterium producing these infections was known as nosocomial staphylococcus. First reports on nosocomial staphylococci are from 1960.[4] The first semisynthetic penicillin-resistant community-acquired strains were reported in the 1980's. Community-acquired and nosocomial staphylococci have certain similarities and differences.[4]

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Clinical cases

Case 1

We report our first case of community-acquired methicillin-resistant staphylococcus isolated from an adult:

A 46-year-old female patient, non-febrile, who consults for a very painful, hot erythematous plaque on the back of right hand (**Figure 1**) of several days' evolution. The patient had suffered a stab wound while working in the garden. A bacteriological sample was obtained and she began treatment with cephalexin. After 48 hours, the wound condition worsened, and the bacteriological test showed resistance to cephalotin, oxacillin, and ampicillin-sulbactam, with susceptibility to the remaining antibiotics: gentamicin, trimethoprim-sulfamethoxazole, amikacin, erythromycin, ciprofloxacin, rifampin. The patient received usual doses of erythromycin: 500 mg every 8 hours, for 10 days, with good response. Drainage was performed twice.

Case 2

An 18-year-old female patient, who consults for pain and inflammation of left upper jaw area. She had a history of multiple body furuncles in forearms and thighs, and had previously received multiple cycles of first generation cephalosporins. Community SAMR was isolated, and she received erythromycin 500 mg every 8 hours for 10 days.

Case 3

A 36-year-old female patient, who consulted for numerous painful furuncles on the back of the thighs. Several treatments with cephalexin had been indicated. Culture yielded SAMR resistant to cephalexin, erythromycin and clindamycin. Treatment: TMP-SMX, 160 mg trimethoprim and 800 mg sulfamethoxazole, 2 tablets every 12 hours, for 10 days.

Comments

S. aureus responsible for child infections is usually classified as nosocomial and community-acquired, according to the epidemiology and molecular bases.[5] Recently, the genomic sequence of the most common community methi-R (methicillin-resistant) *S. aureus* strain in U.S.A. was identified as USA300. This discovery suggests the acquisition of a new genetic weapon, an arginine catabolic mobile element (ACME) by horizontal transmission. *This confers growth and survival advantages over methicillin-susceptible strains*.[2] The high prevalence of ACME in

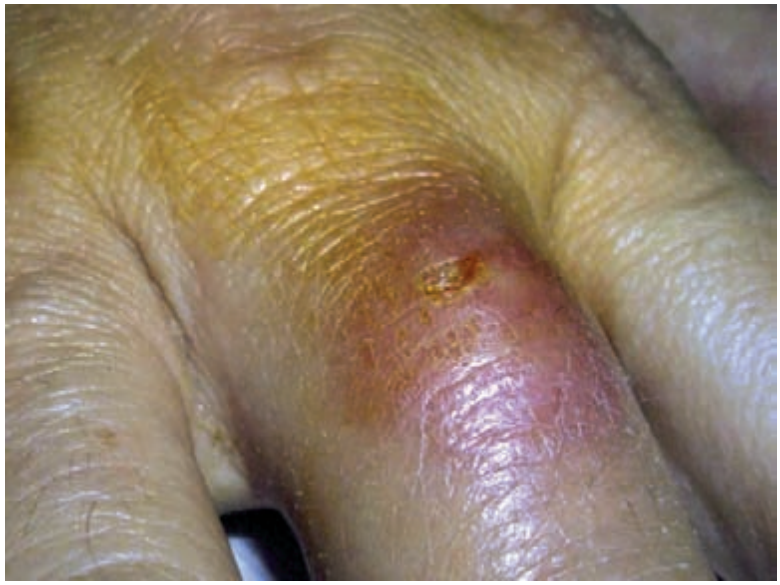

Figure 1. *Red plaque on the back of the hand. The patient attributed the small painful lesion to a spider bite.*

Staphylococcus epidermidis strains, well adapted for skin colonization, suggests that USA300 may have acquired ACME from *S. epidermidis*.[2]

Community methicillin-resistant *S. aureus* strains carry the genes codifying the Panton-Valentine leukocidin toxin, which destroys white blood cells and produces necrosis, skin infections, and necrotizing pneumonia.[4]

Beta-lactamase resistance mechanism includes the presence of a new transpeptidase. The transpeptidase functions by preventing antibiotic attachment to the bacterium wall.[5]

Nosocomial *S. aureus* contains a large gene cassette, which may be I, II, or III; they codify resistance clindamycin, macrolides, and aminoglycosides.[5]

Community *S. aureus* contains a smaller gene cassette, which codifies resistance to beta-lactam ATB. Since it is smaller, it may be contained in a phage, and be rapidly acquired by any staphylococcus.[4] This is type IV gene cassette.[2] The function of the new transpeptidase, also known as penicillin-binding protein (PBP), is the attachment of peptidoglycans in the wall formation, by altering the beta-lactam antibiotics binding site. The gene codifying PBP2a, mecA, is contained in a mobile gene cassette, SCCmec I, II o III that codifies resistance to clindamycin, macrolides, and aminoglycosides in nosocomial methi-R. In community methi-R, the gene cassette is much smaller, the SCC type IV that only codifies resistance by beta-lactamases.[6]

The features of methi-R *S. aureus* infections include a history of receiving antibiotics the previous month, the presence of an abscess, or a lesion attributed to a spider bite, a history of methicillin-resistant *S. aureus* infection or a recent history of close contact with a person with skin infection.[7] Compared to infections by other bacteria, community methi-R *S. aureus* patients refer a spider bite, because the development of very painful lesions.[6]

In addition to receiving previous antibiotic therapy, there may be a history of hospital admittance during the former year; both facts are considered risk factors.[8]

It appears in *defined populations*, such as children, prisoners, Alaska natives, American natives, Pacific islanders, athletes, military personnel, in-

travenous drug addicts[4] and in males having homosexual intercourse.[9] Also in newborn and postpartum.

As regards *positive HIV patients, prevalence is low because they receive trimethoprim-sulfamethoxazole*, which is the *medication of first choice for treating* community methicillin-resistant staphylococcus.[8]

Although most community SAMR infections are limited to skin and soft tissues, the infection may cause death. There were 14 reported cases of adolescents with severe infection by community *S. aureus* who were admitted in intensive care units; 2 of them were SAMS, 13 had lung and joint involvement, and deep venous thrombosis, and 3 died.[5]

Conditions typically due to other bacteria may appear, such as *necrotizing fasciitis*, generally caused by Group A beta-hemolytic streptococcus, *Bacteroides*, *Clostridium*, *Peptostreptococcus,* and *Klebsiella*. Additionally, it may produce purpura fulminans, with extensive necrosis, and sepsis,[9] overinfections of atopic dermatitis,[5] scabiosis,[10] arthritis, osteomyelitis, and deep venous thrombosis.[5] It is associated with staphylococcal sepsis in adolescents, musculoskeletal infections in children, mainly by strains that produce Panton-Valentine toxin. It is also associated with pneumonia, and empyema.[11]

Infections by methicillin-resistant staphylococcus are a globally emerging problem.[11]

They appear as abscesses, with or without surrounding cellulitis in healthy participants of athletic activities, such as weightlifting, football, rugby, volleyball, and boxing. Risk factors for athletes are: skin-to-skin contact, competing while infected, defective hygiene, sharing clothes and equipment.[12] Nasal *S. aureus* carrier state was higher in 2004 than in 2001. Since carrier state precedes infection, this increase is an "important factor" in the emergence of community methi-R *S. aureus*.[13]

Our first patient (Case 1) did not belong to defined populations and did not have any risk factor of SAMR. Cases 2 and 3 had received antibiotics in previous months. Cases 1 and 2 were resistant to cephalotin, oxacillin, and ampicillin-sulbactam (beta-lactams), that is, they were methicillin-resistants. Case 3, in addition to being methicillin-resistant, had resistance to erythromycin and clindamycin.

There are reports of maxillar sinusitis, endocarditis after tongue piercing, and maxillar osteomielitis.[3] *S. aureus* is a Gram-positive, coagulase-negative coccus, and a normal microorganism of the oral cavity. Common maxillo-facial infections caused by *S. aureus* include angular cheilitis and parotiditis.[3]

Methicillin-resistant staphylococcus infections increased between 2000 and 2003 in pediatric patients in Houston. They are associated with a more serious disease than methicillin-susceptible staphylococcus. They may associate with empyema and necrotizing pneumonia. *S. aureus* strains that produce Panton-Valentine toxin are associated with severe sepsis in adolescents and musculoskeletal infections in children.[11] In Uruguay there are reports of 7 deaths.[10] Community SAMR strains did not remain isolated in the community; as expected, but migrated and produced nosocomial infections associated with joint prostheses, in women giving birth, and in newborn.[14]

All isolated strains were susceptible to trimethoprim-sulfamethoxazole, 95 percent to clindamycin, 92 percent to tetracyclins, and 60 percent to fluoroquinolones.[2]

Daptomycin is a cyclic lipopeptide active on the bacterial cytoplasmic membrane, and bactericide in vitro against Gram-positive microorganisms, including *S. aureus*.[2]

Treatment

Treatment of choice is *trimethoprim-sulfamethoxazole*. In allergic patients, clindamycin, 300 mg capsules every 6-8 hours, and rifampin 300 mg/trimethoprim 80 mg every 12 hours.

The FDA approved the fluoroquinolones moxifloxacin and gatifloxacin for uncomplicated skin infections, due to their easy dosage once a day and good tolerance.[16]

Cultures must be done to obtain susceptibility, if the *S. aureus* infection is moderate or severe. Empirical election of therapy before culture depends on local resistances, geographical area, and location and seriousness of the infection. For areas with minimum resistance to staphylococcus, empirical treatment with cephalosporins or erythromycin is still reasonable.[6] In areas where community SAMR appears in 10 percent of total infections or more, clindamycin (oral or IV), or vancomycin IV should be used until susceptibility data is available.

Precaution must be exercised in treating erythromycin-resistant strains with clindamycin, because this treatment may fail. In addition to trimethoprim-sulfamethoxazole, tetracyclines should be considered for adults and older children.[6]

Community-acquired SAMR strains are frequently susceptible to treatment with trimethoprim-sulfamethoxazole, minocycline, doxycycline for 10 to 21 days in uncomplicated cases. Rapid increase in resistance has been recorded with quinolones. Use of topical mupirocin should be limited to short periods, preferably in confirmed cases of *S. aureus*, because of the association of chronic use of mupirocin with significant increase of *S. aureus* resistance.[15]

The oxazolidinone *linezolid* is useful for severe SAMR infections and may be administered orally or intravenously. In some patients, it has been more effective than vancomycin. The minocycline derivative tigecycline is effective against strains resistant to other tetracyclins.[14]

Empirical therapy with vancomycin is recommended in severe infections located in limbs.[6]

Where cultures evidenced methicillin-sensitive *S. aureus*, therapy should return to cephalosporins in order to delay appearance of resistance.[6]

Lindsay-Grayson suggests a treatment triangle for community SAMR. One vertex is wound drainage and debridement, another vertex is culture and antibiogram, and the last vertex is antibiotic treatment with trimethoprim-sulfamethoxazole, clindamycin, or doxycycline (**Figure 2**).[2]

Our first case required lesion drainage twice, because im-

provement did not occur as promptly as expected. Furuncle on upper jaw in Case 2 drained spontaneously at the consultation. In Case 3, several furuncles opened spontaneously, and this contributed to the prompt improvement observed.
Statistically, lesions greater than 5 cm in diameter are predictive of hospitalization, while incision and drainage are effective in managing abscesses smaller than 5 cm.[14]
Important measures are prevention, appropriate hygiene maintenance, no participation of infected individuals in sports events, and not sharing sports equipment.

Conclusion

Currently, the physician should consider the likelihood of being treating a patient infected by a community acquired methicillin-resistant *S. aureus,* because it may cause sepsis. If possible, culture the microorganism responsible for the infection. Consider this possibility if the patient is included in the defined populations, or presents risks factors.
Treatment of first choice is trimethoprim-sulfamethoxazole; in allergic patients, consider clindamycin, erythromycin, doxycycline, and rifampin. If a patient treated with cephalexin does not improve within the expected period of time (72 hours), consider the possibility of methicillin-resistance, and change the antibiotic.

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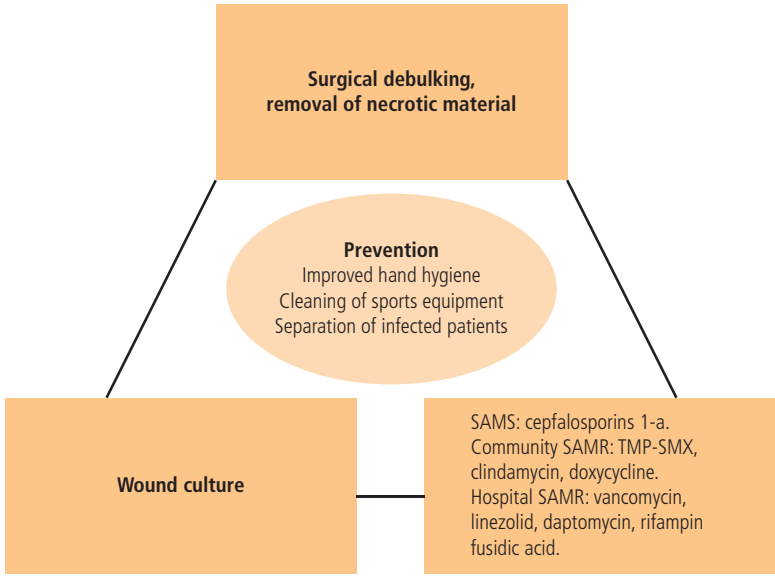

Figure 1. *Red plaque on the back of the hand. The patient attributed the small painful lesion to a spider bite.*

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