Community-Acquired Methicillin-Resistant *Staphylococcus aureus* Infection: Review Questions

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QUESTIONS

Choose the single best answer for each question.

Questions 1 to 4 refer to the following case.

A previously healthy 25-year-old man presents to the clinic with a 3-day history of painful swelling in his left thigh that has been increasing in size. He has been seen in the emergency department 2 times in the past 3 months for similar lesions, which he describes as "spider bites" on his buttocks and abdomen. On physical examination, the patient is afebrile and has normal blood pressure. He has a 3-cm fluctuant mass on his left lateral thigh surrounded by a 4-cm ring of erythema (**Figure**). The mass is warm and tender.

Figure. Photograph of the left thigh of the patient described in questions 1 to 4.

1. **What is the most important next step in this patient's management?**
   (A) Apply topical diphenhydramine and discharge home
   (B) Initiate intravenous (IV) vancomycin
   (C) Obtain cultures and prescribe oral cefalexin
   (D) Perform incision and drainage, obtain cultures, and prescribe oral amoxicillin clavulanate
   (E) Perform incision and drainage, obtain cultures, and prescribe oral clindamycin

2. **The patient presents 1 week later for follow-up. Laboratory cultures obtained from purulent material expressed from the mass demonstrate many gram-positive cocci on Gram stain and *Staphylococcus aureus* growth with the following susceptibility pattern: penicillin R, oxacillin R, cefazolin R, tetracycline S, trimethoprim/sulfamethoxazole S (TMP/SMX), clindamycin S, and erythromycin R. The patient most likely has acquired this strain of bacteria from which of the following?**
   (A) An arthropod vector
   (B) Close physical contact with other athletes at a health club
   (C) Contaminated food
   (D) His grandmother who lives in a nursing home
   (E) Handling reptiles

3. **What additional laboratory testing should be performed to confirm that the antibiotic administered has activity against the methicillin-resistant *S. aureus* (MRSA) strain identified in this patient?**
   (A) D-test
   (B) E-test
   (C) Schlichter test
   (D) Testing for the *mec-A* gene

4. **The patient is concerned by his recurrent infections and asks if *S. aureus* can live in healthy people. Which of the following is the most appropriate response to this patient's concern?**
   (A) Healthy people do not harbor *S. aureus*

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(B) *S. aureus* is only acquired through contact with inanimate surfaces
(C) *S. aureus* colonization is common and affects as many as 20% to 40% of the US population
(D) Only patients with breaks in the skin or chronic disease manifest illness/infection

5. **A previously healthy 16-year-old girl presents to the emergency department with respiratory distress after developing a high fever, dry cough, coryza, and myalgias 2 weeks ago. Her parents add that her symptoms had previously improved, but the patient developed high fever, productive cough, and shortness of breath 1 day prior to presentation. Several family members recently had similar symptoms and were diagnosed with influenza. On physical examination, the patient is febrile (102°F). An initial chest radiograph reveals diffuse bilateral interstitial infiltrates. Due to tachypnea, the patient is emergently intubated. A sputum sample reveals more than 25 white blood cells and less than 10 squamous epithelial cells. There are a large number of gram-positive cocci in clusters, but no other organisms are seen on Gram stain. Initial antibiotic therapy should include which of the following?**
(A) Daptomycin
(B) Gentamicin
(C) Levofloxacin
(D) Linezolid
(E) Ribavirin

ANSWERS AND EXPLANATIONS

1. **(E) Perform incision and drainage, obtain cultures, and prescribe oral clindamycin.** Patients with skin and soft tissue infections due to the newly recognized community-acquired MRSA (CA-MRSA) strains often report lesions that resemble spider bites.[1] The presence of these lesions along with the patient's age and health status represent the classic presentation of CA-MRSA skin/soft tissue infection.[1] Given the clinical features of this patient's carbuncle, drainage is the most important first step followed by obtaining cultures to verify the organism causing the infection. Although the current approach to treating patients with suspected *S. aureus*–infected carbuncles includes drainage, local wound care, and β-lactam antibiotics (eg, cefalexin, amoxicillin clavulanate), CA-MRSA should be taken into account and physicians should be mindful that certain antibiotics will not be effective for treating these infections.[2] Because the patient has a carbuncle that resembles a spider bite with associated cellulitis, oral antibiotics that may have activity against CA-MRSA should be initiated (eg, TMP/SMX, doxycycline, minocycline, clindamycin) instead of empiric β-lactam therapy. At this point, the patient is not systemically ill and does not require IV antibiotics.

2. **(B) Close physical contact with other athletes at a health club.** Based on the susceptibility pattern, *S. aureus* found in this patient is clearly a CA-MRSA strain (oxacillin stands in for methicillin susceptibility in many microbiology laboratories). In contrast to health care–associated MRSA strains that retain susceptibility to only vancomycin, daptomycin, linezolid, tigecycline, and quinupristin/dalfopristin, the newer CA-MRSA strains are often susceptible to clindamycin, TMP/SMX, and tetracycline. A risk factor for acquiring CA-MRSA includes close personal contact with infected individuals; an increased incidence of CA-MRSA infection has been shown in athletes who share common objects (eg, athletic equipment, towels, benches, personal items) contaminated with MRSA.[3–7] Military recruits, prisoners, Pacific Islanders, Alaskan Natives, Native Americans, and men who have sex with men are also at increased risk for CA-MRSA. Although it is possible to acquire MRSA in a nursing home, this patient's age, health status, clinical presentation, and susceptibility pattern suggest that health care–associated MRSA is unlikely. Reptile exposure is a risk for gram-negative infections (particularly *Salmonella* infections). MRSA skin infections are not acquired by ingestion. CA-MRSA has not been shown to be transmitted by arthropods.

3. **(A) D-test.** The D-test is routinely performed on staphylococcal isolates to detect CA-MRSA with inducible resistance. CA-MRSA may have constitutive or inducible resistance to clindamycin. Constitutive clindamycin resistance denotes innate resistance (listed in susceptibility reports as "resistant"), whereas inducible clindamycin resistance refers to drug resistance that is induced by exposure to another macrolide antibiotic (eg, erythromycin). This is important because CA-MRSA with inducible resistance initially may be reported as "sensitive" to clindamycin (as in this case), but resistance to clindamycin may develop quickly after treatment. To perform the D-test, the patient's bacterial growth is measured on a plate with erythromycin and clindamycin discs placed in close proximity. Inducible resistance is indicated by a flattening of the zone of inhibition ("D" shape) as erythromycin diffuses into the same area where clindamycin is present. A positive D-test indicates that therapy with clindamycin should not be used due to the risk of clinical failure. The E-test is a method

for obtaining antibiotic susceptibility information, which has already been established in this case. The Schlichter test, or serum bactericidal activity test, is used to monitor antibiotic therapy in patients with endocarditis, osteomyelitis, and other serious bacterial infections and is not indicated in this case. β-Lactam resistance is conferred to CA-MRSA by the *mec-A* gene. Testing for the *mec-A* gene is helpful prior to obtaining susceptibility results; thus, this test would not provide additional information in this case since susceptibility has already been established.

4. **(C) *S. aureus* colonization is common and affects as many as 20% to 40% of the US population.** Individuals can harbor *S. aureus* without showing signs of infection.[8] As many as 20% to 40% of Americans are colonized with *S. aureus*,[9] with variable rates of colonization among different segments of the population (related to age, sex, and race/ethnicity). The anterior nares are the most frequent sites of staphylococcal colonization, although the groin, rectum, axilla, and umbilicus as well as wounds, chronic skin lesions, and foreign bodies also are possible sites. During outbreaks of MRSA, the environment does not play a significant role in transmission. MRSA is transmitted most frequently through direct skin-to-skin contact;[10] however, the use of shared equipment or other personal items that are not cleaned or laundered between users could be a vehicle for *S. aureus* transmission. Although patients with breaks in the skin are predisposed to skin and soft tissue infections when they are colonized with *S. aureus*, infection can manifest in various settings. It has been postulated that the minor skin trauma and abrasions incurred during physical activity, particularly while participating in contact sports or from rubbing against athletic equipment, may explain outbreaks seen in athletic facilities and teams.

5. **(D) Linezolid.** Based on the patient's clinical presentation and results of sputum testing, she likely has bacterial pneumonia caused by *S. aureus*. An antibiotic with MRSA coverage, such as linezolid, should be initiated for treatment of presumed staphylococcal pneumonia. Prompt treatment is important as demonstrated in 2 recent reports that found a combined mortality rate of 40% in 25 otherwise healthy patients (median age, 21 and 17.8 yr, respectively) with CA-MRSA associated with severe pneumonia following influenza-like illnesses.[11,12] Ribavirin has antiviral properties and is used to treat viral pneumonia, not bacterial pneumonia. Gentamicin would not be the best choice in this setting as it is not used as monotherapy for staphylococcal infections and it only has synergistic activity against gram-positive organisms. Although levofloxacin has extended coverage for *Streptococcus* species, it does not have reliable activity against MRSA. Daptomycin has excellent anti-MRSA activity but does not achieve adequate concentrations in fluid obtained from the epithelial lining of the lungs because it irreversibly binds to lung surfactant.

REFERENCES

1. Naimi TS, LeDell KH, Como-Sabetti K, et al. Comparison of community- and health care–associated methicillin-resistant *Staphylococcus aureus* infection. JAMA 2003;290:2976–84.
2. Fridkin SK, Hageman JC, Morrison M, et al. Methicillin-resistant *Staphylococcus aureus* disease in three communities. N Engl J Med 2005;352:1436–44.
3. Centers for Disease Control and Prevention. Methicillin-resistant *Staphylococcus aureus* infections among competitive sports participants—Colorado, Indiana, Pennsylvania, and Los Angeles County, 2000–2003. MMWR Morb Mortal Wkly Rep 2003;52:793–5.
4. Begier EM, Frenette K, Barrett NL, et al. A high-morbidity outbreak of methicillin-resistant *Staphylococcus aureus* among players on a college football team, facilitated by cosmetic body shaving and turf burns. Clin Infect Dis 2004;39:1446–53.
5. Kazakova SV, Hageman JC, Matava M, et al. A clone of methicillin-resistant *Staphylococcus aureus* among professional football players. N Engl J Med 2005; 352:468–75.
6. Nguyen DM, Mascola L, Brancoft E. Recurring methicillin-resistant *Staphylococcus aureus* infections in a football team. Emerg Infect Dis 2005;11:526–32.
7. Lindenmayer JM, Schoenfeld S, O'Grady R, Carney JK. Methicillin-resistant *Staphylococcus aureus* in a high school wrestling team and the surrounding community. Arch Intern Med 1998;158:895–9.
8. Kuehnert MJ, Kruszon-Moran D, Hill HA, et al. Prevalence of *Staphylococcus aureus* nasal colonization in the United States, 2001–2002. J Infect Dis 2006;193:171–9.
9. von Eiff C, Becker K, Machka K, et al. Nasal carriage as a source of *Staphylococcus aureus* bacteremia. Study Group. N Engl J Med 2001;344:11–6.
10. Centers for Disease Control and Prevention (CDC). Community-associated MRSA information for the public. Available at www.cdc.gov/ncidod/dhqp/ar_mrsa_ca_public.html#10. Accessed 3 Mar 2008.
11. Hageman JC, Uyeki TM, Francis JS, et al. Severe community-acquired pneumonia due to *Staphylococcus aureus*, 2003–04 influenza season. Emerg Infect Dis 2006;12:894–9.
12. Centers for Disease Control and Prevention (CDC). Severe methicillin-resistant *Staphylococcus aureus* community-acquired pneumonia associated with influenza—Louisiana and Georgia, December 2006–January 2007. MMWR Morb Mortal Wkly Rep 2007;56:325–9.

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