My Case Study

By Samantha Yager

Sara is 23 years old and was recently hospitalized for two weeks due to pneumonia. She was treated with Azithromycin and Vancomycin intravenously and began to recover from the pneumonia. She was discharged and given Doxycycline to take orally for the next 10 days. One week after being discharged from the hospital she began to notice a couple of red, painful bumps under her left armpit and one on her right buttock. Sara was also extremely fatigued and running a low grade fever.

1. What disease does her doctor suspect and why? (This is a differential diagnosis, trying to figure out what diseases it might be, not what it is just yet. Limit yourself to the most likely five.)

1. Sara may be developing boils. Boils develop in moist areas such as the armpits, groin, buttocks, thigh, or back of the neck. Someone with a boil may also experience fever and fatigue. [1]

2. *Pseudomonas aeruginosa* is a common cause of nosocomial infections such as folliculitis. It causes a rash that appears as small red bumps and may be accompanied by low grade fever and fatigue. [3]

3. Hiradenitis suppurativa may be the cause of the bumps. It is a skin condition that causes pea to marble sized lumps that can appear in the armpits, groin, buttocks, or under the breasts. [4] The fever and fatigue could be a result of her body still fighting pneumonia.

4. Herpes simplex type 2 can cause small blisters or sores and flu-like symptoms. [5] Although sores are normally in the genital area, they can in rare cases appear in other areas of the body.

5. Methicillin Resistant *Staphylococcus aureus* (MRSA) may be the cause of Sara’s symptoms. MRSA usually presents as red, painful, pus filled bumps and can cause fever. [6]

Sara had an appointment with her physician 3 days later. The bumps had begun to be filled with pus by the time she went for her appointment. The doctor ordered a test to determine if she had contracted MRSA.

2. What type of testing is done to diagnose MRSA? Be sure to be specific about the details of the tests.
Diagnostic testing for MRSA can include a skin culture from the infected area, culture of drainage from the infected area, blood or urine culture, and sputum culture. Culture is the most common test used to detect MRSA. It allows for conformation that *Staphylococcus aureus* is present, as well as allowing the organism to be qualified. A nasal swab or swab from the infected area is performed and put onto a nutrient medium, incubated and then monitored for growth. The results are usually available in about 48 hours. [7]

**What happened in 2008 to improve testing for MRSA? How did it improve testing?**

A rapid blood test that can detect MRSA was approved by the U.S. Food and Drug Administration in 2008. This test can detect the meca gene that causes the antibiotic immunity in MRSA. This new molecular test can provide results in 1-2 hours instead of 1-2 days. The test is however more expensive than culture. [7]

**Sara’s lab results came back positive for MRSA.**

**3. What are the treatment options for her disease?**

MRSA is treated with an antibiotic regiment. Bactrim and vancomycin are two antibiotics that are normally given as initial treatment of MRSA. If these fail, other antibiotics such as clindamycin, minocycline, Tygacil, Cubicin, Zyvox and Synercid may be used. Due to the resistance of MRSA to so many antibiotics and its ability to grow resistance so easily, it is often difficult to find an antibiotic that will work. Skin boils may be cut open and drained. [8]

**How is MRSA categorized? Which category does Sara’s case most likely fall under and why?**

The setting in which MRSA is acquired determines its categorization. There are two types of MRSA which are healthcare-acquired MRSA (HA-MRSA) and community-acquired MRSA (CA-MRSA). HA-MRSA has been recognized since the 1960s and occurs in patients in hospitals and healthcare facilities. These patients have had surgery; medical devices implanted, or weakened immune systems. CA-MRSA became a growing concern beginning in the 1990s and occurs in places like childcare centers, boot camps, prisons and other long term facilities. It is also seen in athletes who have skin to skin contact or share equipment. The problem with CA-MRSA is it is difficult to identify the source of the infection. The two types of MRSA differ at the genetic level and these differences suggest that CA-MRSA may spread more easily and cause more skin problems than HA-MRSA. [9] Sara most likely has HA-MRSA that she contracted during her hospital stay due to her weakened immune system.

**4. What are the major virulence factors of the disease?**
Major virulence of MRSA is due to its ability to produce toxins and its adhesion proteins. [10] *S. areus* has two very unique virulence factors which are its ability to perform several functions with one virulence factor and the ability of multiple virulence factors performing the same task. *S. areus* adheres to its host by way of “microbial surface components recognizing adhesive matrix molecules” (MSCRAMMs). *S. areus* forms a biofilm that plays a role in its virulence by providing a safe haven for the bacterium to live and grow. There are several other factors that contributed to the virulence of *S. areus* which include leukocidins involved in evading and destroying leukocytes; proteases, lipases, elastases, and other enzymes involved in tissue invasion; and the production of enterotoxins including toxic shock syndrome toxin-1, exfoliative toxins A and B, peptidoglycan, and lipoteichoic acid that are involved in toxin-mediated disease and sepsis. [12] The toxins produced by MRSA are pore-forming and attack the cell membrane by poking holes in it. [14]

**What has contributed to the emergence of CA-MRSA?**

There are new clones of MRSA arising that may be contributing to the emergence of CA-MRSA strains. Acquisition of Panton-Valentine leukocidin genes and increased expression of core genome-encoded toxins may be the reason these strains are becoming more prevalent. [10] The mecA gene, which is responsible for causing methicillin resistance in HA-MRSA, is also responsible for reducing the bacteria’s ability to secrete cytolytic toxins. CA-MRSA expresses less of the penicillin-binding protein 2a, which is encoded by mecA, leading to a more virulent strain of MRSA that is capable of moving into the community. [11]

**5. Explain methods for controlling/preventing the disease.**

Proper hand washing is the best defense against the spread of MRSA. Isolating the infected individual, keeping wounds covered, avoid sharing of personal items, shower after contact sports, sanitize linens, and properly disinfecting surfaces are all ways to help prevent the spread of MRSA. [13] According to the CDC, it is not always practical to prevent the spread of MRSA because most infected people are not easily identifiable.

**Is a vaccine available?**

There is currently no vaccine for MRSA, however, researchers at the University of California, San Diego, believe they may have a vaccine that could help prevent MRSA. This new vaccine would combine nanoparticles and material from red blood cells, forming a nanosponge, which would allow for the MRSA toxins to attack these nanosponges instead of red blood cells. The removal of toxins from the bacteria makes it more vulnerable to the immune system. [14]

**References:**