The role of antibiotic usage in the acquisition of community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) among Division III football players at Moravian College

Introduction

Bacteria are prokaryotic organisms that exist in all habitats. In humans, many species are transported in the anterior nasal passages (or aerodigestive tracts) and the community. The genus Staphylococcus is characteristic of Gram-positive cocci that exist as single cells or in clusters of two to four. Like many bacteria, staphylococci are common flora of the skin but become infectious when ingested via contaminated portals such as wounds, gastric or respiratory tracts, hair follicles and glands. Bacteria in this genus are gram-positive (non-spore forming) and cause local cutaneous infections (LCIs) such as folliculitis and impetigo as well as systemic infections like osteomyelitis. Staphylococcal aureus is the most pathogenic species of staphylococcus. With a generation time of 20-30 minutes and the ability to grow in conditions of high salt concentration and between 10 and 40°C, S. aureus has great potential for virulence. An example of a serious systemic epidermal infection is that of staphylococcal scarlet skin syndrome, or SSSS. As is true for most bacterial infections, treatment includes antibiotics to help the immune system combat the bacteria causing the infection. However, evolution has resulted in mutations that enable potentially harmful bacteria such as S. aureus to resist the chemical activity of antibiotics.

Resistance to therapeutic antibiotics began only a few years after Alexander Fleming’s penicillin was first used in 1941. Methicillin-resistant S. aureus, or MRSA (Figure 1), is one of numerous bacteria that has mutated into a form only treatable with the highest doses of very few antibiotics. While the fam. gene differentiates S. aureus from other staphylococci, mecA is one gene that differentiates MRSA from methicillin-susceptible (non-resistant) S. aureus (MSSA). Since the 1980s, MRSA has increased in prevalence more than any other antibiotic-resistant bacteria (Figure 2). If diagnosed late, invasive administration of antibiotics and surgery to remove infected tissue are two of only a few viable options for treatment. An-risk populations include hospital patients of long-term stay (i.e. ICU) and athletes in contact sports such as football and wrestling.

The goals of my research are:

1. To examine the prevalence of MRSA through nasal carriage among members of the 2006 Moravian College football team through various laboratory methods.
2. To determine the efficiency of Hibiclens® in preventing LCIs.
3. To investigate possible correlations of susceptibility to MRSA, based on past antibiotic usage of each player.

Results

Although 247 nasal swabs were acquired, only 258 can be analyzed due to coding error with 29 samples. 29 samples were taken at pre-season, mid-season and post-season.

Pre-season – 21 of 79 (42.4%) tested MSSA positive. Blood plasma and 33 of 79 (41.8%) tested positive on CHROMagar S. aureus. None of these samples tested positive on CHROMagar MRSA plates.

Mid-season – MSSA, coagulase and CHROMagar S. aureus resulted in the same number of positive tests throughout (51 of 80, 63.6%). Fifty of 80 samples (62.5%) showed positive results on CHROMagar MRSA indicating that MRSA may be present in these samples.

Post-season – 54 of 79 (67.9%) of post-season nasal samples were MSSA positive. 19 (24.1%) magenta colored blood plasma and 51 of 79 (64%) tested positive on CHROMagar S. aureus. CHROMagar MRSA media tested positive three times indicating positive MRSA presence.

Materials and Methods

Nasal cultures.

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Figure 5 shows the trend in percent positive nasal culture results over the course of the season. By the end of the season, each test was yielding positive results than at the start of the season, with the exception of CHROMagar MRSA media. Although there appears to be no rising trend of possible MRSA carriage through the course of the season, the low percentage of samples testing positive is not necessarily indicative of a decreasing trend in MRSA. Rather, MRSA may have been present in the anterior nares and not successfully cultured.

Discussion

Vertically the same number of wound samples, 169 and 167, tested positive on both MSSA and CHROMagar MRSA plates. The CHROMagar MRSA results were consistently higher than the MSSA, CHROMagar S. aureus and coagulase testing identified 39.3% ± 2.4% of samples as S. aureus. These consistent percentages of positive results show that all three tests perform equally well in determining the identity of S. aureus bacteria from clinically isolated samples.

Unlike several other teams within the conference, Moravian’s football team did not experience an outbreak of MRSA during the 2006 season. With such a small sample size of careful MRSA, discrepancies with use of Hibiclens® and the high likelihood of all wounds being spread or controlled within the team over the course of the season. Rationale: The significance of this study suggests that Hibiclens® is not 100% effective, it is important to keep in mind the potential for error associated with this data due to the methods of using Hibiclens®. Although a number of samples tested positive on LCIs, only a few occurred over the course of the season. This suggests that the use of Hibiclens® is effective in the control of MRSA.

In an effort to investigate increased susceptibility to MRSA based on past antibiotic usage, players were contacted numerous times to retrieve their family physician contact information, but few responded. Of respondents, physicians were contacted and only one sent back a report. This player had not received any antibiotic prescriptions from that office. The Moravian College Health Center was also contacted to retrieve antibiotic prescription information. Data collection from this location is ongoing.

At this time, CHROMagar MRSA results have shown that eight of the 88 players who enrolled in the study may be carriers of MRSA and 21 may have been exposed at some point during the season. PCR analysis of these 29 samples is now being conducted to determine the presence of mecA (indicating MRSA) and macA (indicating MSSA) in each sample. Regardless of these test results, no athletes required treatment for LCIs caused by MRSA during the 2006 season, therefore indicating that Hibiclens® may save as a sufficient measure with which to prevent MRSA from infecting players in the locker room.

Wound cultures.

Throughout the football season, 402 wound cultures were acquired and analyzed. 169 ± 42.0% of all samples tested positive on MSSA. Of the total 88 wound samples, 13 (15.8%) harbored bacteria that present morphology similar to standard MRSA on CHROMagar MRSA media, suggesting MRSA presence in these wounds. Figure 7 shows the trend of wound culture analysis, as each subset of the total.

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References


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