Antimicrobial susceptibility patterns in microbial isolates from orthopedic patients at the UC Davis VMTH

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Background
- Previous studies have shown infection rates between 3.3% and 7.1% in clean surgical orthopedic procedures with some procedures having an even higher rate of infection.1
- Other clean surgical procedures report lower infection rates, between 0.8% and 4.8%.1,2
- Bacteria are able to form biofilms on orthopedic implants which protects them from the animal's immune system and antibacterial therapy.1
- The majority of bacterial isolates from infections associated with orthopedic procedures are Gram-positive bacteria, such as Staphylococcus and Streptococcus.3,4,5
- An increase in antimicrobial resistance has been reported in other studies, especially with Staphylococcus aureus and β-lactam antibiotics. These resistant bacteria are frequently methicillin-resistant Staphylococcus pseudintermedius (MRSP).3,4,5
- A rise in antimicrobial resistance may be attributed to historic indiscriminate administration of antibiotics, thereby selecting for bacteria with the resistance genes. (Figure 2)
- At the UC Davis Veterinary Medicine Teaching Hospital (VMTH), coagulase-negative is often identified as the dominant bacterial species during surgical procedures to reduce the chance of infection. However, coagulase-negative is a member of the β-lactam family and is therefore ineffective against MRSP and many other resistant bacteria.
- Animals that develop a surgical site infection (SSI) have an increased morbidity, resulting in additional patient suffering and increased costs for owners.2
- Every hospital has a unique population of resident bacteria and therefore have varying resistance patterns.3
- Previously, no studies had been completed looking at the overall increase in antimicrobial resistance in microbes isolated from orthopedic procedures at the UC Davis VMTH.

Hypothesis
There has been an emergence of more resistant microbes, especially methicillin resistant S. pseudintermedius sp, as well as multi-drug resistant organisms in implant associated infections in orthopedic patients.

Methods
- A total of 4923 aerobic culture results from the UC Davis VMTH microbiology lab were examined to identify 941 that were associated with orthopedic related procedures.
- Results were further reduced to 840 isolates that represented the major genera isolated. These genera were: Acinetobacter spp., Aerococcus viridans, Corynebacterium spp, Enterobacter spp., Enterococcus spp., Escherichia coli, Enterococcus sp, Pasteurella spp., Proteus spp, Pseudomonas spp., Staphylococcus spp., Staphylococcus schleiferii sp. coagulans, Staphylococcus aureus, Staphylococcus intermedius group, coagulase-negative (CoN) Staphylococcus, β hemolytic Staphylococcus spp., and Streplococcus viridans.
- Identified 5 major categories of bacteria: Escherichia coli (n=66), Pseudomonas sp. (n=67), Staphylococcus aureus (n=85), Staphylococcus intermedius group (n=331), and coagulase-negative Staphylococcus (n=192).
- Prior to 2007, S. intermedius was believed to be the major staphylococcal cultured from canine patients, but studies in molecular reclassification have shown these to be S. pseudintermedius.3 For this reason, all S. intermedius & S. pseudintermedius were grouped in this study under “Staphylococcus intermedius group”.
- Compared minimum inhibitory concentration (MIC) data with current Clinical and Laboratory Standards Institute (CLSI) breakpoints to determine susceptibility for each microbe/antimicrobial combination.1,2
- Created antibiograms for each 5 year period for the 5 microbe groups listed above.

Figure 2: How Antibiotic Resistance Occurs

Large numbers of bacteria present. Some resistant to antibiotics. Antibiotics are given. Susceptible bacteria are killed. Resistant bacteria survive. Bacteria can transfer their resistance genes to other bacteria, turning them resistant.

Discussion
- The Staphylococci were the main pathogens isolated with S. intermedius group comprising 35% of all orthopedic related SSI's, which is likely due to this pathogen being part of the resident skin flora.
- Of the 166 S. intermedius group isolates cultured from 2010-2015, 48% of them were oxacillin (methicillin) resistant strains (MRSP). This is consistent with findings from other studies that have reported between 39-56% oxacillin resistance.4,6
- Similarly, 41% of coagulase-negative Staphylococcus (n=19) and 53% of S. aureus (n=34) isolates from 2010-2015 are oxacillin resistant.
- The increase of multi-drug resistant S. intermedius group isolates is concerning for successful treatment of orthopedic infections. Out of the 83 isolates that were found to be multi-drug resistant (MDR) strains from 2010-2015, 79% (65/83) were resistant to five or more classes of antibiotics.
- The apparent increase in antimicrobial resistance from orthopedic infections may be an indication to change the antimicrobials that are used prophylactically.
- The antibiograms generated by this study may be useful for clinicians to determine the most appropriate empiric antibiotic therapy for any given situation, as well as to monitor changes in resistance over time within the UC Davis VMTH.

Based on the results of this study, successful treatment of orthopedic infections may require aggressive antimicrobial therapy and other non-drug modalities such as removal of implants and debridement of infected tissues.5

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References

Table 1: Cumulative MIC & MIC50 data for Staphylococcus intermedius group isolates obtained from dogs.

Table 2: Cumulative MIC & MIC50 data for Staphylococcus intermedius group isolates obtained from dogs.