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Staphylococcus capitis Osteomyelitis: Case Report

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Abstract

This case report describes an unusual invasive infection with *Staphylococcus capitis*, in a child with a history of repaired congenital heart disease and an acute presentation of osteomyelitis. Coagulase-negative staphylococci are rare causes of osteomyelitis without an implanted device in the bone and, as such, should prompt evaluation for associated infections that may be contributing to the unusual presentation. Additionally, this case highlights the importance of considering methicillin heteroresistance in staphylococcal infections when the clinical course is not proceeding as expected.

Keywords

Coagulase negative staphylococci, Staphylococcus capitis, osteomyelitis; endocarditis

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Case

A 10-year-old male with a history of complex congenital heart disease presents with a 1-week history of fatigue, fever, and limp. His cardiac history was significant for truncus arteriosus and interrupted aortic arch, with multiple surgical corrections, including right ventricle to pulmonary artery conduit in infancy and bioprosthetic valve replacement of a damaged native aortic/truncal valve approximately 1 year prior to presentation. On examination, he appeared tired but in no distress. Vitals are as follows: blood pressure = 97/88 mm Hg, heart rate = 120 beats per minute, respiratory rate = 18 breaths per minute, temperature = 38.5°C, and O_2 100% on room air. Cardiac auscultation is significant for a II/VI early systolic murmur best at left sternal border. This is unchanged from his prior cardiac examination in location; however, the intensity was increased and the S2 widely split and fixed. Examination of skin reveals onychopagia to fingernails bilaterally otherwise unremarkable. Musculoskeletal examination notable for limp favoring right lower extremity with normal range of motion and no point-tenderness with palpation. A transthoracic echocardiogram performed on the day of presentation failed to demonstrate intracardiac thrombi or vegetations; however, the conduit was not well visualized. The transthoracic echocardiogram revealed moderate left ventricular hypertrophy with overall vigorous left ventricular function and mild aortic stenosis but no aortic regurgitation. There was evidence of replacement of the pulmonary valve with a valved right ventricular to pulmonary artery connection, mild pulmonary stenosis, and no significant pulmonary regurgitation. These findings were consistent with those seen on an echocardiogram that was obtained 1 year prior to presentation.

The patient was admitted to the hospital where he was found to have elevated C-reactive protein (6.9 mg/dL) and erythrocyte sedimentation rate (44 mm/h). Three sets of blood cultures were also obtained at 6-hour intervals and all positive for 2 strains of *Staphylococcus capitis.* Culture and susceptibility results demonstrated methicillin-susceptible *S capitis* species. Transesophageal echocardiogram was obtained on hospital day 3 and did not demonstrate any obvious thrombi or vegetations, but again could not fully visualize the conduit. This echocardiogram was otherwise unchanged from his transthoracic

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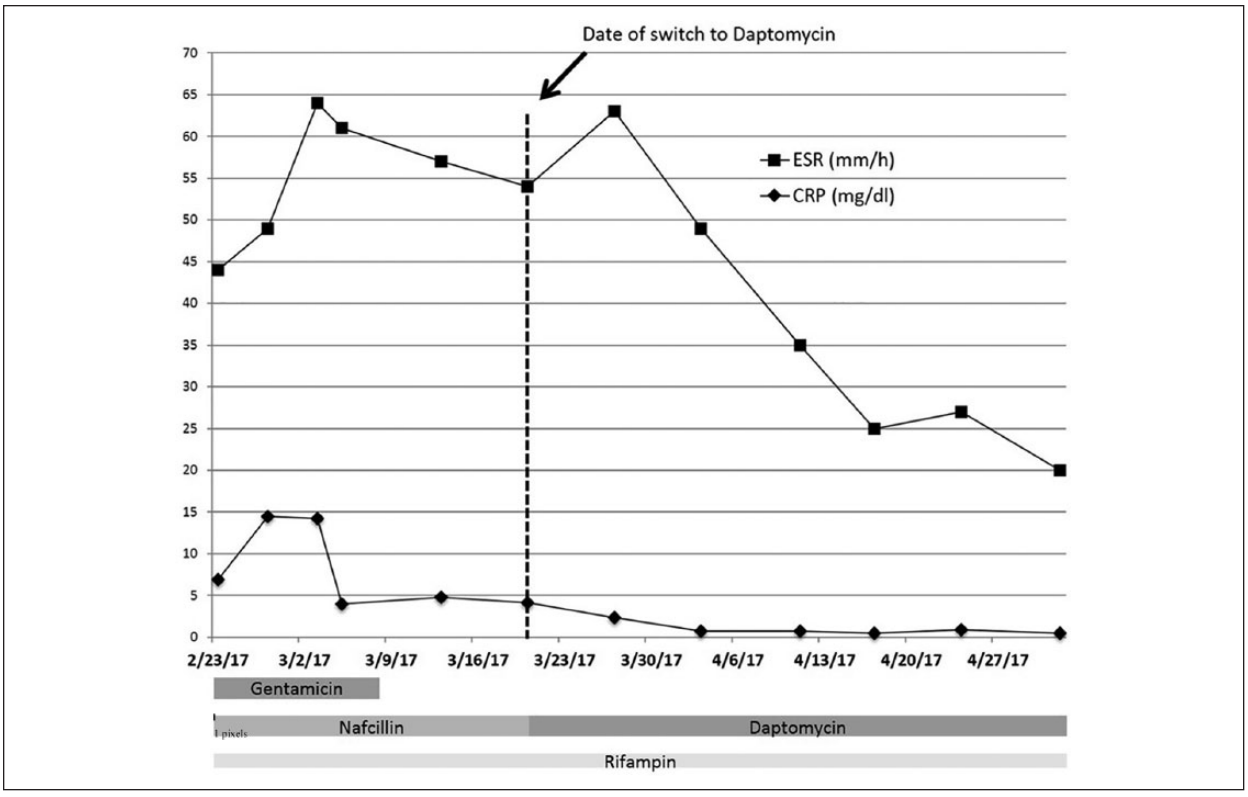

Figure 1. Changes in C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) over time from diagnosis and initiation of therapy (February 23, 2017) to end of therapy, with a marked decrease following change to daptomycin.

echocardiogram on the day of presentation, detailed above. Due to his limp, an X-ray and subsequently a magnetic resonance imaging of the right lower extremity were obtained and demonstrated osteomyelitis of the proximal tibia. Orthopedic surgery was consulted, and as no abscess or fluid collection was evident on magnetic resonance imaging, medical management was recommended.

Final Diagnosis

Based on the patient's extensive cardiac history and persistent *S capitis* bacteremia, he was suspected to have bacterial endocarditis with resultant osteomyelitis from hematogenous bacterial spread and was started on antibiotic therapy.

Hospital Course

The patient was started on nafcillin, gentamicin, and rifampin therapy with quick resolution of his limp, fatigue, and fever. He completed 2 weeks of gentamicin therapy, with a plan for 6 to 8 weeks of nafcillin and rifampin. At follow-up in the infectious disease clinic 1 week after hospitalization, while still on nafcillin and rifampin, it was noted that his inflammatory markers had plateaued with a C-reactive protein 5.8 times upper limit of normal and an erythrocyte sedimentation rate 2.6 times upper limit of normal (Figure 1). At that time, his energy and activity levels had returned to baseline, and his examination was unchanged. Due to concern for the presence of a subpopulation of methicillin-resistant *S capitis* with new plateau in inflammatory markers, the patient was switched from nafcillin to daptomycin therapy, with continuation of rifampin. After changing antibiotics, the plateau in his inflammatory markers quickly resolved and levels fell into normal range. A follow-up transthoracic echocardiogram obtained 2 months after hospitalization did not demonstrate the presence of thrombi or vegetations. He was again seen in the infectious disease clinic shortly after the echocardiogram was obtained, and antibiotics were discontinued at that time. The patient completed 70 total days of antibiotic therapy, 47 of which were combination daptomycin/rifampin therapy.

Discussion

Coagulase-negative staphylococci (CoNS) are a heterogeneous subset of the *Staphylococcus* genus characterized as opportunistic nosocomial pathogens frequently associated with the use of indwelling or implanted

foreign bodies.[1] *S capitis*, in particular, is a CoNS species found predominantly on the scalp and arms of humans. *S capitis* has been occasionally implicated in catheter-related bloodstream infections, device-related bone and joint infections, and prosthetic valve infectious endocarditis.[1]

Like other CoNS, its pathogenicity stems from biofilm formation. *S capitis* resistance to β-lactam antibiotics such as methicillin is common and is due to the presence of the *mecA* gene. The *mecA* gene encodes for penicillin-binding protein 2a, which greatly diminishes binding affinity for β-lactam antibiotics.[1] A trait unique to methicillin-resistant *Staphylococcus* is its heterogeneous expression of the *mecA* gene. While all strains show some resistance to low-concentration β-lactams, there are few subpopulations that demonstrate resistance to high-dose β-lactams.[2] In this case, the incomplete response to β-lactam antibiotics despite susceptibility testing indicating methicillin-susceptible staphylococci is likely due to heterogeneous resistance in the staphylococcal colonies, which is not unusual in staphylococci.[2,3] The patient's initial improvement in clinical symptoms and inflammatory mediators may have been a result of nafcillin's effective killing of the methicillin-susceptible colonies within the population, but the *mecA*-positive colonies were allowed to persist. However, as detailed subpopulation analysis was not clinically available, this cannot be confirmed. Daptomycin has been shown to have excellent antimicrobial activity in the setting of biofilm infections, which may have also contributed to the patient's clinical improvement.[4] This highlights the importance of recognizing the potential for methicillin heteroresistance in staphylococcal infections, the difficulty in treating biofilm infection with certain classes of antibiotics, and adjusting therapy appropriately in the setting of clinical failure.

S capitis osteomyelitis is an uncommon occurrence with a literature review demonstrating 3 total cases, 1 of the acetabulum, 1 of the tibia, and 1 of the jaw.[5-7] While *S capitis* is a rarely reported cause of invasive infection in children this age, this may be underreported due to the lack of coagulase-negative staphylococcal speciation in many clinical microbiology laboratories.

Osteomyelitis typically occurs via hematogenous spread, trauma, surgical instrumentation, or the presence of foreign bodies or implanted prostheses.[8] In the pediatric population, hematogenous spread is the most common route of transmission with the metaphysis of long bones in the lower extremity being the most common site of infection.[8] This patient's age, positive blood cultures, and the location of his osteomyelitis in the metaphysis of a long bone are all suggestive of hematogenous osteomyelitis. Given the unusual organism and his extensive cardiac history, it is suspected that this osteomyelitis was secondary to hematogenous spread from prosthetic valve endocarditis (PVE), but this cannot be confirmed.

CoNS are an important pathogen in PVE. They are second only to *S aureus* as the most common causative organism overall, and are the most common cause in early PVE (infection <2 months after valve implantation).[9,10] *S capitis* PVE is an uncommon occurrence with only 6 cases previously reported in the literature.[11,12] In all 6 cases, the onset of presentation was within 4 months of valve replacement surgery. The present case is unique in that the onset of symptoms was just over 1 year after the patient's most recent cardiac surgery (aortic/truncal valve and RV-PA conduit replacement), which is outside of the usual timeframe for CoNS PVE to present.

Conclusion

With the increasing use of implantable prosthetic material and indwelling catheters, coagulase-negative staphylococcal species are becoming a prominent pathogen for nosocomial infections. Here we presented a rare case of *S capitis* PVE and osteomyelitis and provided evidence from the literature that, although uncommon, *S capitis* does possess similar pathogenic potential as more well-known CoNS species. This case highlights the importance of considering other sources of infection when a patient presents with an unusual organism and the potential for CoNS methicillin heteroresistance and other microbiologic attributes complicating antibiotic treatment of these infections.

Author Contributions

All authors contributed to the development of the manuscript and the care of the patient presented. All authors approved the final manuscript.

Declaration of Conflicting Interests

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Ethical Approval

Institutional review board approval is not required for deidentified single case reports or histories based on institutional policies.

Informed Consent

The patient's mother consented to the publication of this deidentified case report.

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