Osteomyelitis in Children — Diagnosis and Treatment

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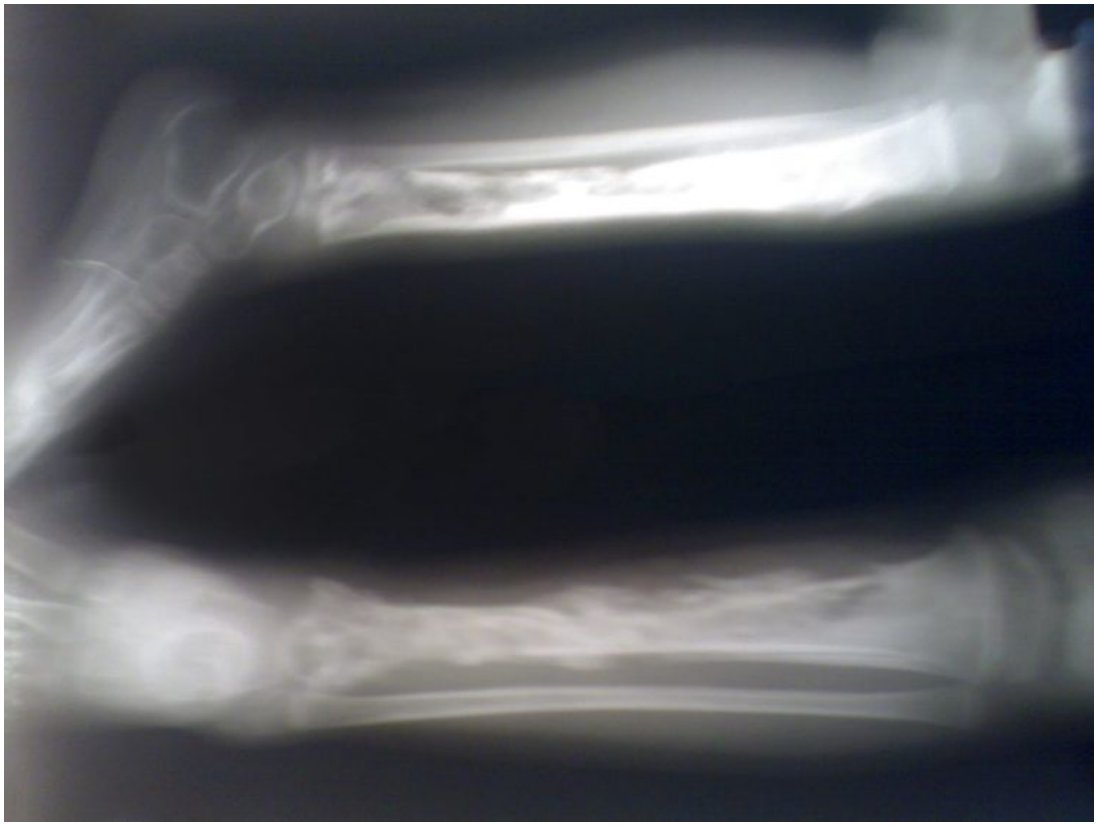
Children are at risk of developing osteomyelitis, an inflammation of the bone that is infectious in etiology. Neonates are more likely to develop the multifocal disease while infants and children usually develop osteomyelitis of a single long bone. Patients present with a fever that is associated with localized swelling, tenderness, redness and warmth over the shaft of a long bone in the leg or arm. C-reactive protein is usually elevated and x-ray or magnetic resonance imaging of the affected bone confirms the diagnosis. Antibiotic therapy is the main mode of treatment in children with osteomyelitis.



Definition of Osteomyelitis in Children

Osteomyelitis, as the name implies, is an **acute inflammation of the bone** that is usually caused by a **bacterial pathogen,** hence infectious in etiology. Acute osteomyelitis in children is a condition that is most commonly caused by the **hematogenous spread** of potential pathogens.

Epidemiology of Osteomyelitis in Children

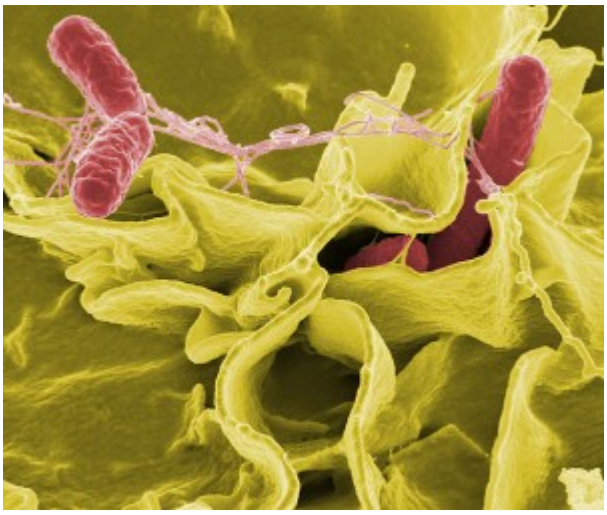
The incidence of acute osteomyelitis in children in the United States is estimated to be around 8 per 100,000 per year. However, the incidence rate in people of lower **socioeconomic status** or in countries with low-income is significantly higher. Additionally, the severity of the condition and subsequent complications is correlated with the socio-economic status.

Patients residing in resource-limited countries usually present late to the clinic when the disease has already advanced. Due to the delayed presentation, these patients are also more likely to develop **complications,** contract **sepsis** or **die**.

- Boys > girls
- More common < 5 years old
- 80 % in tubular bones
- **50 % in femur, tibia or fibula**

Pathophysiology of Osteomyelitis in Children

While osteomyelitis in adults is more commonly a complication of soft-tissue infection such as cellulitis or septic arthritis, **hematogenous spread** is mostly implicated in the pathogenesis of osteomyelitis in children. Still, direct spread of adjacent structures such as **infected skin or joints** is also responsible for a significant number of cases of osteomyelitis in children.



Color-enhanced scanning electron micrograph showing Salmonella Typhimurium (red) invading cultured human cells

The most commonly identified organism in osteomyelitis in children is **staphylococcus aureus**. **Streptococcus pneumoniae** and **streptococcus pyogenes** are also commonly identified as possible causative organisms of osteomyelitis in children. Patients who are not vaccinated against **Haemophilus influenzae type b** are at risk of developing osteomyelitis caused by this bacterium. Haemophilus influenzae is more commonly associated with septic arthritis.

Patients who have **sickle cell anemia** are at risk of developing salmonella osteomyelitis. However, the commonest cause of osteomyelitis in this population of children remains staphylococcus and streptococcus species. Salmonella **osteomyelitis** is rarely seen in children who are otherwise healthy.

Another specific group of patients is those **younger than 4 years of age**. If this group of patients develops osteomyelitis, they are at risk of acquiring **Kingella kingae**.

Clinical Presentation of Osteomyelitis in Children

Osteomyelitis can be **acute**, **subacute** or **chronic**. Acute osteomyelitis in children is defined as an acute bony infection of fewer than two weeks duration. When the disease lasts between two weeks and three months, the term subacute is used. Children with chronic osteomyelitis usually have bony lesions that have lasted more than three months.

Usually, a **single bone** is affected by osteomyelitis in children but the **multifocal disease** has also been described, especially in neonates. Patients present with **fever**, **weight loss,** and **anorexia**.

Localized symptoms to the affected area include redness, swelling, pain, and tenderness to palpation. The patient might also have symptoms suggestive of septic arthritis such as complete loss of range of motion of an adjacent joint, swelling of the joint, redness and warmth to touch. **Lower extremities** are more commonly affected compared to upper limbs.

Patients can also develop **back pain**, or pain on rectal examination due to **sacral osteomyelitis**. Young children can present with fever of unknown origin, i.e. fever for more than two weeks without an apparent cause.

Patients presenting with high-grade fever, tachycardia, toxic appearance and a painful limp with an inability to support their weight on their lower legs are more likely to have Staphylococcus aureus related osteomyelitis.

- Persistent fever
- Pain over an area of involvement
- Children with leg osteomyelitis may have refusal to walk as their primary symptom
- Abdominal pain and constipation in children with vertebral osteomyelitis

Diagnostic Workup for Osteomyelitis in Children

Patients presenting with acute localized bony tenderness, warmth, redness and swelling, especially if associated with a fever, are suspected to have osteomyelitis. The first step in the evaluation of these patients is to conduct some **blood laboratory investigations** including c-reactive protein, erythrocyte sedimentation rate and a complete blood count.

C-reactive protein and **erythrocyte sedimentation rate** are usually elevated in patients with osteomyelitis. These are markers of inflammation. A **complete blood count** might reveal **leukocytosis** with a shift towards **neutrophils**.

When a single bony segment is affected, **x-ray imaging** of that bone can be helpful. Looking for signs suggestive of osteomyelitis such as **edema**, or **abnormal shadowing of the bone border** points toward possible osteomyelitis. In chronic osteomyelitis, there is sequestrum formation, new bone formation over dead bone and an opening for the draining sinus.

If the patient has elevated c-reactive protein levels and/or elevated erythrocyte sedimentation rate that is supported by an abnormal x-ray, the probability of osteomyelitis becomes high. In case of **negative results** in the previous examinations,

the treating physician should re-evaluate the situation. If the patient has a history of **sickle cell disease**, has other signs that are linked to osteomyelitis such as **septic arthritis** or is **immunocompromised**, then further workup might be needed.

The next step in the diagnostic workup of these patients is to perform **advanced imaging studies of the affected bones**. Magnetic resonance imaging is superior to computed tomography in the identification of soft-tissue involvement. A **bone biopsy** is useful in confirming the presence of bacteria.

Patients who have normal c-reactive protein levels, normal erythrocyte sedimentation rate, and normal x-rays but appear **toxic and feverish** should be admitted to the hospital. At that stage, a **blood culture** should also be performed. Repeat measurement of c-reactive protein levels and erythrocyte sedimentation rate the next day is indicated for these patients.

If the markers of inflammation become elevated or the blood culture results come back positive for any organism known to be associated with osteomyelitis, then these patients should undergo **magnetic resonance imaging** of the suspected involved area to assess the bone and soft tissues around the bone.

Differential diagnosis

- **Leukemia**
- Bone cancer
- Fracture and incidental fever
- Chronic recurrent multifocal osteomyelitis

Treatment of Osteomyelitis in Children

First-generation cephalosporins or **cloxacillin**, **nafcillin** or **oxacillin** are first-line empirical antibiotics for acute osteomyelitis in children. These antibiotics should be administered intravenously at first and the patient should be reassessed in two to four days.

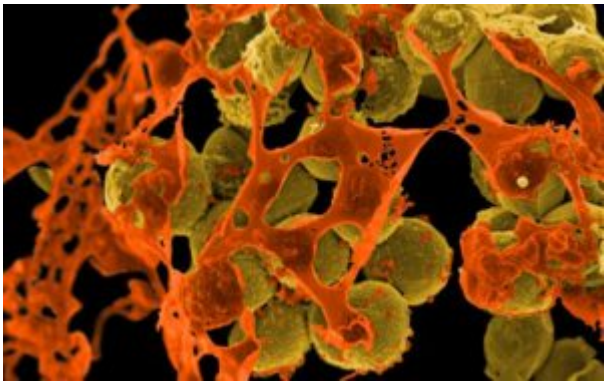


Image: “Scanning electron micrograph of methicillin-resistant Staphylococcus aureus (MRSA, brown) surrounded by cellular debris. MRSA resists treatment with many antibiotics.” by NIAID/NIH. License: Public Domain

If the patient does not show any clinical improvement after four days of antibiotic therapy, or the c-reactive protein levels in the blood do not decrease, the patient might have **methicillin-resistant Staphylococcus aureus**.

At that point, the availability of culture results should be checked and the choice of

antibiotics should be switched to something more specific to the causative organism and its antibiotic-sensitivity profile. Another possible cause of failure to respond to antibiotic therapy is the formation of an **abscess**. Therefore, surgical consultation is recommended at this stage.

If the patient is confirmed to have methicillin-resistant Staphylococcus aureus then that patient's medication should be switched to **clindamycin** or **vancomycin**. Abscesses should be drained surgically. If the patient does not have any bacterial strain that is resistant to the given antibiotic, then the same antibiotic should be used but at a higher dosage.

If the patient shows a good response after four days of intravenous antibiotic therapy, then the same starting antibiotic should be continued, this time orally. Antibiotics should be prescribed for up to three weeks and c-reactive protein levels should be checked again by the end of the third week of oral antibiotic therapy.

Usually, most patients show **significant clinical improvement** and complete normalization of c-reactive protein after three weeks of consistent antibiotic therapy. At that stage, antibiotic therapy should be discontinued. If the c-reactive protein level is not yet normal by three weeks or the patient still has residual signs suggestive of osteomyelitis, then treatment with oral antibiotics should be continued until **complete resolution of symptoms** is achieved.

References

Acute osteomyelitis in children via nih.gov

Notes