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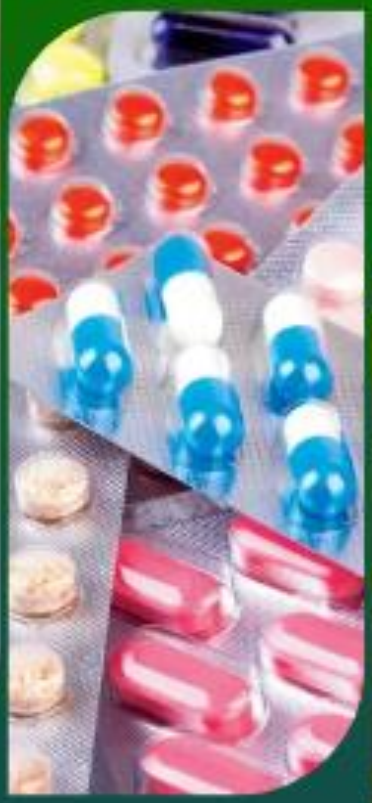

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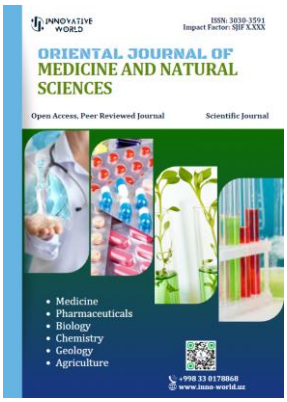


# DETAILED DIAGNOSIS OF HEMATOGENOUS OSTEOMYELITIS IN CHILDREN

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**Abstract.** Hematogenous osteomyelitis in children is a serious bone infection that spreads through the bloodstream, requiring prompt diagnosis and treatment to prevent complications such as growth disturbances and deformities. This study explores clinical presentations, laboratory markers, and imaging techniques for accurate diagnosis. Magnetic resonance imaging (MRI) remains the gold standard, while microbiological investigations enhance pathogen identification. A comprehensive, multidisciplinary approach integrating clinical, laboratory, and imaging findings is crucial for effective management and improved outcomes.

**Keywords:** Hematogenous osteomyelitis, pediatric infection, bone infection, diagnosis, MRI, microbiology

**Relevance of the topic**

Hematogenous osteomyelitis in children, an infection typically spread through the bloodstream, requires a meticulous diagnostic approach to ensure timely and effective treatment. This note provides a comprehensive overview, expanding on the key points and incorporating all relevant details from recent research and clinical guidelines, aimed at healthcare professionals and informed lay readers.

**Introduction and Clinical Context**

Hematogenous osteomyelitis, often acute in children, is primarily an infection of the bone originating from blood-borne pathogens. It predominantly affects the long bones, with the femur and tibia being the most common sites, accounting for 27% and 26% of cases, respectively, as noted in studies like Acute haematogenous osteomyelitis in children. The condition is critical to diagnose early, as delays can lead to growth disturbances, deformities, or even death, emphasizing the need for a high index of suspicion, especially given the insidious presentation in some children.

**Clinical Presentation and Initial Assessment**

The diagnostic journey begins with clinical suspicion, driven by symptoms such as fever (present in up to 75% at admission), pain, swelling, erythema, and warmth in the affected area. Children may exhibit difficulty bearing weight or a pronounced limp, particularly with lower limb

involvement, and pelvic cases might show a waddling gait. The presentation can vary, with symptoms often lasting 6–8 days before diagnosis, and up to 35% may have contiguous septic arthritis, complicating the picture. This variability underscores the importance of a thorough history and physical examination, as highlighted in Acute Hematogenous Osteomyelitis in Children: Clinical Presentation and Management.

**Laboratory Evaluation: Inflammatory Markers and Microbiology**

Laboratory tests are pivotal for confirming suspicion. Initial evaluation typically includes a complete blood count (CBC), C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR). Research suggests CRP is elevated in up to 98% of cases, making it highly sensitive but nonspecific, and it's preferred for monitoring due to its shorter half-life (19 hours, normalizing in 7–10 days) compared to ESR (2–3 weeks), as detailed in Acute Hematogenous Osteomyelitis in Children. The white blood cell count, however, has a sensitivity of only ~35%, and its role is more about ruling out other conditions like leukemia or malignancy.

Microbiological diagnosis is crucial, with blood cultures yielding a pathogen in 20–46% of cases, while bone exudates, abscesses, or aspirates can identify pathogens in 65–82%, often being the only diagnostic means in nearly half the cases. For children under 5 years, enhancing recovery of fastidious organisms like *Kingella kingae* by inoculating samples into blood culture bottles is recommended, with a total detection rate of ~33%. Anaerobic, fungal, and mycobacterial cultures have low yields (1–3%) but are considered in immunocompromised patients or those with atypical symptoms. Molecular methods, such as multiplex PCR-based panels, can increase *K. kingae* identification by 2–4 fold, with 89% diagnosed by molecular means in some series, though these are expensive and not always available.

**Imaging Techniques: From Initial to Definitive**

Imaging is a cornerstone of diagnosis, starting with plain radiographs, which are recommended to exclude alternative causes like fractures or bone tumors, though they may not show changes until 2–3 weeks into the infection. Ultrasound is sensitive for detecting joint effusions and can guide aspirations, while technetium-99m bone scintigraphy is useful for ill-defined sites or multifocal disease, though it may have false negatives in infants. The gold standard, however, is magnetic resonance imaging (MRI), with sensitivity of 97–100% and specificity of 92%, capable of detecting changes within 2–5 days and identifying complications like pyomyositis or abscesses in up to 68% of *Staphylococcus aureus* cases. Limitations include cost, availability, long scan times, and the need for sedation, as noted in Hematogenous Osteomyelitis in Infants and Children: Imaging of a Changing Disease.

Computed tomography (CT) is generally not recommended due to lower sensitivity compared to MRI and higher radiation exposure, making it less suitable for pediatric patients. The choice of imaging must balance diagnostic

accuracy with practical considerations, such as access to MRI facilities and the child's ability to cooperate during the scan.

**Flowchart: Diagnosis of Hematogenous Osteomyelitis in Children**

**1. Clinical Suspicion:**

- Fever
- Localized bone pain, tenderness
- Swelling, redness, warmth
- Limited range of motion

**2. Initial Evaluation:**

- **Laboratory Tests:**
  - Complete Blood Count (CBC) (↑ WBC)
  - C-Reactive Protein (CRP) and Erythrocyte Sedimentation Rate (ESR) (elevated)
  - Blood Culture

**3. Imaging:**

- **X-ray:** Initial imaging (may be normal in early stages)
- **MRI:** Preferred for early detection and soft tissue involvement
- **Ultrasound:** Useful for detecting subperiosteal abscess
- **Bone Scan:** Consider if MRI is unavailable

**4. Definitive Diagnosis:**

- **Bone Aspiration/Biopsy:**
  - Gram stain & culture
  - Histopathology

**5. Diagnosis Confirmed?**

- **Yes:**
  - Initiate treatment: IV antibiotics
  - Surgical drainage if needed
- **No:**
  - Consider alternative diagnoses (e.g., malignancy, trauma, arthritis)

**Diagnostic Challenges and Considerations**

Diagnosing hematogenous osteomyelitis can be challenging due to the variability in presentation and the potential for false negatives in early stages, particularly with imaging like plain radiographs. The role of procalcitonin remains unclear, with some studies suggesting it may aid diagnosis but lacking consensus, as seen in Acute Hematogenous Osteomyelitis in Children. Additionally, the increasing prevalence of community-associated methicillin-resistant *Staphylococcus aureus* (MRSA) complicates microbiological diagnosis, necessitating culture and sensitivity testing to guide antibiotic therapy.

In infants, the disease may present differently, with a higher risk of multifocal involvement (5–10%), and imaging strategies may need adjustment, such as considering bone scans where MRI is not feasible. The multidisciplinary approach, involving pediatric infectious disease specialists,

orthopedists, and radiologists, is essential to integrate clinical, laboratory, and imaging findings for a definitive diagnosis.

**Table:** Diagnostic modalities for hematogenous osteomyelitis in children

| Modality | Purpose | Advantages | Limitations |
|---|---|---|---|
| **Clinical Assessment** | Identify symptoms (fever, pain, swelling) | Non-invasive, initial step | Subjective, may be insidious |
| **CBC, CRP, ESR** | Confirm inflammation, monitor response | CRP highly sensitive, ESR supportive | WBC low sensitivity, nonspecific |
| **Blood Cultures** | Identify pathogen | Non-invasive, guides therapy | Yield 20–46%, may be negative |
| **Bone/Joint Cultures** | Definitive microbiological diagnosis | High yield (65–82%), crucial for resistant strains | Invasive, requires procedure |
| **PCR (Molecular)** | Detect fastidious organisms (e.g., *K. kingae*) | Increases detection, rapid | Expensive, limited availability |
| **Plain Radiography** | Rule out fractures, tumors | Widely available, initial screening | Poor early detection, changes after 2–3 weeks |
| **Ultrasound** | Detect joint effusions, guide aspirations | Non-invasive, no radiation | Limited for bone changes |
| **Bone Scintigraphy** | Detect multifocal disease, ill-defined sites | Sensitive, useful in infants | False negatives possible, radiation exposure |
| **MRI** | Gold standard, detect early changes, complications | High sensitivity (97–100%), specificity (92%) | Cost, availability, sedation needed |

This table encapsulates the diagnostic toolkit, highlighting the complementary roles of each modality in achieving a timely and accurate diagnosis.

## Conclusion

The diagnosis of hematogenous osteomyelitis in children is a multifaceted process, integrating clinical suspicion with laboratory confirmation and advanced imaging. MRI stands out as the preferred imaging modality for its early detection capabilities, while laboratory tests like CRP and cultures are vital for confirming infection and guiding therapy. The approach must be tailored to the child's age, presentation, and access to resources, ensuring a balance between diagnostic accuracy and practical feasibility.

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