

Overview of Paediatric Bone and Joint Infections

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ABSTRACT

Paediatric bone and joint infections are common, and can be challenging to diagnose due to significant variation in the signs and symptoms depending on the age of the patient, site of infection and causative organism. Both septic arthritis and osteomyelitis are common, often co-existing. Surgeons must have a consistent approach to investigation and management of these patients to minimise morbidity from unrecognised or undertreated infection. We provide an overview of the epidemiology, presentation, investigation and management of both septic arthritis and osteomyelitis in children.

Key words: Osteomyelitis; Septic arthritis; Pediatric orthopaedics; Pediatric infectious diseases

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INTRODUCTION

Infectious diseases are common in children, and can affect the musculoskeletal system. Bone and joint infections (BJI) are a common presentation to paediatric orthopaedics. Haematogenous BJI can occur in the form of osteomyelitis (OM), septic arthritis (SA) or combined osteomyelitis-septic arthritis (OM-SA), all of which require a differing approach to diagnosis and management. Paediatric orthopaedic surgeons must be able to recognise BJI and treat it appropriately in order to minimise morbidity, which can be significant if not recognised and treated appropriately. This article discusses the epidemiology of BJI in the paediatric population, presenting features, diagnosis and management of BJI in children.

EPIDEMIOLOGY

Bone and joint infections are common in the paediatric population. The reported incidence varies from 2 to 13 cases per 100,000 population in developed countries to as high as 200 cases per 100,000 population in developing countries^[1]. Some studies have found that osteomyelitis and septic arthritis have a similar prevalence^[2,3]. The majority of cases occur in patients under three years of age, with incidence decreasing with increasing age^[4]. The highly vascularised nature of the metaphysis in young children means that haematogenous spread of organisms from other sites can occur more easily than in older children and adults^[4]. Other risk factors for BJI include male gender^[3], sickle cell disease^[5] and any immunocompromise (particularly chronic granulomatous disease)^[6].

Causative pathogenic organisms

A number of infective organisms have been implicated in the development of BJI. The most likely organism varies by age: clinicians must be aware of this as it influences the empirical antibiotic therapy that should be prescribed. No organism is identified in 55% of suspected cases of BJI^[7]. Most cases are due to gram positive organisms. Table 1 below shows major pathogenic organisms.

Sites of infection

The most common joints affected by septic arthritis are the hip and knee. In cases of osteomyelitis the lower limb predominates, with 20-30% of cases in the femur and 19-26% of cases in the tibia^[4,14]. Typically only one bone is affected, but multifocal infection occurs in

Table 1 significant pathogenic organisms in bone and joint infections in childhood.

Organism	Associated features
Staphylococcus aureus	Estimated prevalence 75-90% [8] Methicillin-sensitive Staph aureus is most common, but the incidence of MRSA & PVL-positive species are rising [9]
Streptococcus species	
Kingella kingae	Estimated prevalence 15-40% [1,11,15] Most common pathogen in children aged <4 years of age [10,12] May require 16S rRNA gene PCR to identify
Salmonella species	High association with osteomyelitis in patients with sickle cell disease
Haemophilus influenza	Previously a major cause Now very rare due to widespread vaccination in childhood

up to 10% of cases (particularly in younger patients)^[13]. All bones can be affected: BJI should be considered as a differential diagnosis for any child with unexplained bone pain, regardless of site.

PRESENTING FEATURES

The presenting symptoms of BJI vary by the site of infection and age of the patient. Pain is the most common presenting feature (80%)^[11], and 60% of patients have fever. 50% have a reduced range of motion in the joint and 50% have reduced weight-bearing through that joint. In young infants pseudoparalysis is an important sign^[15] as is irritability, but symptoms are often non-specific and the diagnosis can be challenging as a result. There may or not be erythema at the site of infection. Consider septic arthritis of the hip in any infant with fever when another cause is not clearly identified.

Osteomyelitis can be classified based on the duration of symptoms as acute (< 2 weeks duration), subacute (< 3 months duration) or chronic (> 3 months)^[16]. Septic arthritis typically has an acute presentation over days rather than weeks.

DIAGNOSIS: LABORATORY TESTS

There is no definitive diagnostic test for bone and joint infections: diagnosis is based on a combination of clinical features along with suggestive imaging, microbiological and biochemical investigations.

The Kocher criteria can be used as part of the diagnostic work-up of suspected septic arthritis^[17]. Four criteria were measured: history of fever, non-weight bearing status, erythrocyte sedimentation rate > 40 mm/hr and white blood cell count >12 × 10⁹/L^[17]. The prevalence of septic arthritis of the hip in patients with none of these features was 0.2% but was 93.1% for patients with three of four criteria and 99.6% in patients meeting all four criteria. A CRP > 20 mg/L is also indicative of septic arthritis^[18].

The European Society for Paediatric Infectious Diseases recommends a full blood count, CRP and ESR for any patient with suspected bone and joint infection^[15]. Procalcitonin is not recommended as it has a low sensitivity and positive predictive value^[19].

It is vital to obtain blood cultures: diagnostic yield has increased in recent years due to the introduction of real-time 16S rRNA testing for *K. kingae*^[20]. Cultures should be obtained prior to the administration of antibiotic therapy: in adult studies, antibiotic administration has been shown to decrease the growth of *streptococcal* species in cultures^[21].

DIAGNOSIS: IMAGING

All patients with suspected BJI should have an X-ray of the affected bone or joint as a baseline investigation and to rule out other possible mimics such as fracture^[15]. Further imaging depends on whether osteomyelitis or septic arthritis are suspected.

Septic arthritis

X-rays are often normal in septic arthritis. Clinicians should be vigilant for abnormal positioning of the hip: the hip is often held in flexion, abduction and external rotation in septic arthritis to maximise the capsular volume. In infants, asymmetry of the hip joint space due to an increase in the medial joint space (Waldenstrom's sign^[22]) may be present but can be subtle sign.

In suspected arthritis ultrasound is the most sensitive test and has no associated risk of radiation. In most hospitals it can be obtained rapidly and easily, and it does not require the child to be given a general anaesthetic. Ultrasound has a high sensitivity (86%) and specificity (90%) for joint effusion^[23] but cannot definitively differentiate between transient synovitis and septic arthritis. The results must be interpreted in conjunction with the patient's clinical features and results of blood tests.

Osteomyelitis

80% of plain X-rays are normal in the first two weeks in patients with osteomyelitis^[23]. If the X-ray is abnormal, possible features include a bony lucency (intraosseous abscess), soft tissue swelling and a periosteal elevation^[25]. A sequestrum may be visible in chronic cases as a focal sclerotic lesion with a lucent rim.

The most sensitive imaging modality in early OM is MRI, which has the additional advantage of involving no ionising radiation^[9,26]. MRI can detect abnormalities within three to five days of disease onset. Additionally it allows detection of subperiosteal abscesses and sequestra, allowing for surgical planning. However, MRI can be difficult to obtain and a general anaesthetic is often required for younger patients and thus in circumstances where a patient is well it may be reasonable to treat prior to imaging.

MANAGEMENT: ANTIBIOTICS

Antibiotics are the mainstay of treatment of BJI. The most appropriate antibiotic depends on the results of cultures and sensitivity. Empirical therapy is based on the most likely causative organism: this varies based on patient age, location and co-morbidities^[26]. Patients under age 5 must be treated with antibiotics that have activity against *Kingella*: flucloxacillin notably has poor activity against *Kingella* and thus another antibiotic may be advisable.

Most children with BJI should be treated initially with IV antibiotics. ESPID advise that IV antibiotics should be continued until there is clinical improvement, absence of fever and a decrease in CRP by 30-50% of the initial value^[15]. The total duration of antibiotic should be at least 2-3 weeks for SA and 3-4 weeks for OM. Patients with resistant organisms (MRSA or PVL+ strains), newborns and those with complications may require longer courses of therapy^[27].

MANAGEMENT: SURGICAL CONSIDERATIONS

Surgery is rarely required for osteomyelitis: 90% of patients with

early osteomyelitis achieve cure with antibiotics alone^[28]. Surgical drainage of subperiosteal abscesses may be required, particularly if the patient fails to respond to antibiotic therapy.

Septic arthritis is a surgical emergency and must be treated as soon as possible to prevent damage to the joint. A joint aspirate can be performed, which must be followed by a wash-out of the joint to remove any pus or infected effusion.

CONCLUSION

Septic arthritis and osteomyelitis of native joints are common in the paediatric population and must be recognised and treated to prevent long-term sequelae. Clinicians should be vigilant when assessing any child with bone pain and fever. Diagnostic investigations should be interpreted with caution: a careful history and examination must be taken to allow appropriate identification of these patients- diagnostic algorithms must not replace clinical judgement.

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