Bone and joint infections

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Abstract

Children presenting with a limp pose a diagnostic dilemma for the clinician. Children may present to a number of specialities, hence, confidence in the examination of the joints, and the musculoskeletal system is essential. There should be a high index of clinical suspicion for infection of the bones or joints, in the acute presentation of a child with a painful limp, and particularly, in the non weight-bearing child. This article will discuss the clinical presentations of paediatric bone and joint infections. The approach to clinical assessment, laboratory and radiological investigations, and management of these conditions, will be discussed. Caring for patients with bone and/or joint infections, often involves several specialities; emergency department doctors, general paediatricians, orthopaedic surgeons, radiologists, paediatric rheumatologists, and the paediatric physiotherapy teams. Early and close collaboration between teams will result in prompt investigation and age appropriate care.

Keywords chronic recurrent multifocal osteomyelitis; limp; osteomyelitis; reactive arthritis; septic arthritis

Bone and joint infections

The evaluation of a child with the presentation of a swollen joint is a challenging diagnostic dilemma, as there are numerous possible causes (Table 1). Excluding trauma and considering infection as a cause of the swollen joint, or acute presentation of a limp, is essential. The child with the swollen joint may present to various specialities, primary care, accident and emergency or to orthopaedics. Symptoms are not easily offered by younger children. The diagnosis is usually clinical, as investigations may not be diagnostic and must be interpreted in the clinical context.

Bacterial infection of the bone (osteomyelitis) or joint (septic arthritis) should be suspected in infants or children who present with:

- fever
- unexplained limp and/or abnormal posture or gait
- reluctance to use the limb or will not weight bear if lower limb affected
- musculoskeletal pain ± presence of local bone or joint tenderness, swelling or erythema
- complete or partial limitation of movement on examination.

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Osteomyelitis or septic arthritis may occur separately or together. Septic arthritis may affect one or many joints depending on the organism and the state of the host immunity.

Osteomyelitis

Osteomyelitis is easy to misdiagnose. It is often preceded by a history of trauma in the affected extremity and in the early stages radiological signs may be absent. The femur and tibia are most commonly affected. Osteomyelitis is more common in boys, affecting ages less than 1 year or 3–10 years, more commonly. The frequency of osteomyelitis is greatest in infants. 33% of all cases occur in the first 2 years of life and 50% of osteomyelitis occurs by 5 years of age. Infection is usually seen in the metaphyseal region of bones. Most infections are spread via the haematogenous route from a primary site of entry (e.g., respiratory, ear, nose or throat (ENT), skin). Infection may also occur by direct inoculation (open fractures, penetrating wounds), or local extension from adjacent sites. In the neonate or infant transphyseal vessels are patent and infection may spread to the adjacent joint causing a septic arthritis.

Types of osteomyelitis

- Acute and Subacute (2–3 weeks duration)
- Chronic, may develop sequestrum and involucrum
- Bone abscesses, may develop surrounding thick fibrous tissue and sclerotic bone (Brodie's abscess)
- Chronic Recurrent Multifocal Osteomyelitis (an autoinflammatory condition)

The yield for bacterial growth from synovial fluid and bone aspirate is small. Organisms are not always isolated. *Staphylococcus aureus* is most common in children in all age groups.

Septic arthritis

Septic arthritis is an infectious arthritis of a synovial joint, and is a medical emergency. Causes are shown in Table 2. It poses a unique challenge to the paediatrician, paediatric rheumatologist and orthopaedic surgeon. Prompt recognition, early diagnosis with identification of the causative organism and institution of the appropriate medical and surgical intervention is imperative to prevent destruction of the joint and hence prevent permanent disability.

The incidence in the childhood is 2–10 per 100,000, in the general population. The frequency is highest in young children with half of all cases presenting in the first 2 years of life. It is more common in boys with a consistent male: female ratio of 2:1.

Septic arthritis can result from direct entry of bacteria into the joint following a puncture injury, haematogenous seeding of bacteria into the joint space, or contiguous spread from adjacent infections (osteomyelitis or cellulitis). Haematogenous spread is seen most commonly in neonates and infants because a network of blood vessels traverses from the metaphysis to the epiphysis, allowing bacteria and pus to cross into the joint space. The synovial membrane is highly vascular and lacks a limiting basement membrane which allows bacteria to seed the synovial space. After the first year of life, the vessels become gradually obliterated by the epiphysis formation, which reduces by some

Differential diagnosis of a swollen joint

Trauma
- Accidental injury
- Non-accidental injury

Infection
- Acute septic arthritis
- Viral arthritis
- Reactive/Post-infectious arthritis

Malignancy
- Acute leukaemia
- Neuroblastoma

Autoimmune
- Juvenile idiopathic arthritis
- Systemic lupus erythematosus
- Juvenile dermatomyositis
- Systemic sclerosis
- Mixed connective tissue disease
- Arthritis associated with inflammatory bowel disease

Systemic vasculitis
- Henoch-Schonlein purpura
- Kawasaki disease
- Polyarteritis nodosa

Haematological
- Sickle cell anaemia
- Haemophilia

Genetic disorders
- Down's syndrome
- Stickler syndrome
- Cystic fibrosis
- Velocardiofacial syndrome -22q11

Autoinflammatory syndromes
- CINCA syndrome (Chronic Infantile Neurological, Cutaneous and Articular syndrome)
- SAPHO syndrome (Synovitis, Acne, Pustulosis, Hyperostosis, Osteitis syndrome)
- Familial Mediterranean fever

Orthopaedic
- Perthe's disease (usually presents with limp)
- Pigmented villonodular synovitis

Miscellaneous
- Transient synovitis
- Drug reactions
- Sarcoidosis

Table 1

degree the chance of infection spreading into the joints in older children.

The joint most commonly involved is the knee, (75% are in the lower limb), but other joints, including the hip, ankle, wrist, elbow and shoulder and small joints can be affected. Fever is present in up to 70% of cases and may be accompanied by rigors.

The typical presentation of septic arthritis will be a history of acute fever with an acute onset of limp or inability to weight bear. The pain can be so intense that a pseudoparalysis of the involved limb can occur. There will be decreased range of movements, pain on passive motion of the joint, and/or a hot, erythematous swollen joint to find on examination. However, there are a number of caveats to remember when concerned about a diagnosis of septic arthritis or osteomyelitis. Up to 50% of patients may not have a fever. Infants may not appear unwell. There may be underlying septic arthritis or osteomyelitis in a child with systemic signs of infection. In less than 10% of cases more than one joint is affected (except gonococcal infection).

Aetiology per age group

- Less than 12 months old — *Staphylococcus aureus*, Group B *Streptococcus*, Gram-negative bacilli
- 1—5 years — *Staphylococcus aureus*, *Haemophilus influenzae*, Group A *Streptococcus*, *Streptococcus pneumoniae*
- 5—12 years — *Staphylococcus aureus*, Group A *Streptococcus*
- 12—18 years — *Staphylococcus aureus*, *Neisseria gonorrhoea*

Recent trends in the UK show an increased incidence of community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA). As a result many antimicrobial policies in many hospitals for septic arthritis now include clindamycin which has good action against CA-MRSA. Panton—Valentine Leukocidin (PVL) secreting *Staphylococcus aureus* has been described in children and adolescents. It is more aggressive and has a predilection for causing multifocal osteomyelitis. Special requests to look for the gene encoding PVL *Staphylococcal aureus* can be made when samples are sent for tissue diagnosis.

In certain regions, particularly in Europe and the Middle East, *Kingella kingae* has become one of the most common pathogens. The rising incidence is mostly attributable to progressive PCR techniques used for its detection. *Kingella* produces milder infections, is responsive to antibiotics, and tends to affect the cartilaginous epiphyses.

Investigation of septic arthritis

The definitive test for septic arthritis is aspiration of the joint for synovial fluid analysis. Withdrawal of fluid may also allow symptomatic relief, particularly with large effusions. General anaesthesia for joint aspiration is dependent on the age of the child and the joint involved. Our experience suggests that children less than 8 years old will require full general anaesthetic but it will sometimes be possible without anaesthesia, with the use of nitrous oxide. However, if the orthopaedic team proceeds from aspiration to lavage and arthroscopy of the joint, a general anaesthetic is usually required.

Synovial fluid analysis involves gram staining, microscopy, culturing and PCR techniques to identify the causative organism. The synovial fluid characteristically is cloudy or turbid, has a very high white cell count (WCC 50 to 3000 $\times$ 10^9/L) which is predominantly neutrophils and is positive on gram stain in approximately 50% of cases. Culture of the synovial fluid is positive in up to 70% of cases, with a corresponding yield upon blood culture in 40—50% of cases. Specific media may be needed to isolate and identify potential pathogens in the synovial fluid.

Although a high synovial fluid white cell count (more than 5 $\times$ 10^9/L) is suggestive of an infection, similar findings can occur in reactive arthritis and even in early chronic arthritis. Furthermore, synovial white cell counts may be only mildly increased in proven septic joints. A significant proportion of children with probable septic arthritis have persistently negative cultures (even