Paediatric osteoarticular infections

Bhavuk Garg*

*Assistant Professor
Department of Orthopaedics
AIIMS, New Delhi

INTRODUCTION
Paediatric osteoarticular infections remain a significant important cause of morbidity world-wide. Although many concepts regarding pathogenesis, diagnosis and treatment of paediatric osteoarticular infections have remained constant over the years, understanding regarding various other aspects have continued to evolve. Clinicians caring for children need to be especially well versed in these infections. Although our understanding of the mechanisms of these infections has not changed much over the last several years, knowledge of the changes in the epidemiology of these infections should be used to guide evaluation and treatment.

Our understanding of the epidemiology of paediatric osteoarticular infections is changing rapidly. Osteomyelitis is inflammation of the bone caused by infection with bacterial or fungal organisms. Osteomyelitis often is categorized into three different types:

1. Acute hematogenous osteomyelitis
2. Osteomyelitis secondary to contiguous spread of infection after trauma, puncture wounds, surgery
3. Osteomyelitis secondary to vascular insufficiency

Acute hematogenous osteomyelitis is seen most often in children. Osteomyelitis caused by contiguous spread of infection is less common in children, and infection secondary to vascular insufficiency is rare in children.

The exact incidence of osteoarticular infections is unknown. However it is known to occur at the rate of approximately 1 per 10,000 children, younger than 12 years per year. The incidence has not been found to be higher in any one race than another. Acute haematogenous osteomyelitis is most common in childhood with a peak incidence in neonates. Half of all cases of osteomyelitis occur in children under 5 years old. There is a seasonal variation, the hospital admission rate for osteomyelitis peaking in late summer and autumn. The incidence is greater in boys than girls and the male to female sex ratio increases with age. The timing of diagnosis and identification of a causative organism is the key to rapid institution of appropriate therapy.

The most commonly affected long bones are the tibia and femur but involvement of almost every bone in the body has been reported. A study of 163 infants and children with osteomyelitis, the femur, tibia, and humerus accounted for 68% of infections. Most cases are limited to a single site, with less than 10% involving two or more locations. The metaphysis of long bones is the most usual site for acute haematogenous osteomyelitis. Theories to account for this fact include decreased blood flow in sinusoidal vessels in this area and relative paucity of phagocytic cells in this area. Animal studies have shown that isolated bacteraemia does not lead to osteomyelitis but bacteremia plus a traumatic injury to the metaphysis produces osteomyelitis. Although many children give a history of minor trauma, it is very rare to see osteomyelitis complicating a closed fracture treated by non-operative means. However, other features of the epidemiology including the male preponderance and peak incidence still remain unexplained.

Septic arthritis may occur at any age and in any joint but is particularly common in children, in the hip and knee. Half of all cases of septic arthritis occur in those less than 20 years old. Rates of septic arthritis are estimated to be between 5.5 and 12 cases per 100,000 children with a peak incidence in the early years of the first decade. Immunocompromised hosts may have a higher incidence, particularly those suffering from inflammatory arthritis of any type. Two recent reports have identified an increased incidence of septic arthritis in children who have hemophilia and are HIV positive.

In certain anatomical sites the bony metaphysis is intra-capsular and bone infection may lead to a septic arthritis, e.g. upper end of femur, proximal humerus. The bony metaphyses of children younger than 18 months are vascularised by the transphyseal vessels. Because these vessels enter the epiphysis and ultimately the joint space, young children are believed to have a higher risk of joint space infection.
complicating osteomyelitis. Sixty to 100% of neonates with septic arthritis will have adjacent osteomyelitis. Septic arthritis and osteomyelitis usually result in poor outcomes in up to 27 and 40% of children, respectively. Complication rates from septic arthritis are associated with a delay in diagnosis of more than 4 to 5 days, onset in infancy, infection with S. aureus or Gram negative bacteria, and infection of the adjacent bone.

Pyomyositis is a bacterial infection of skeletal muscle with a predilection for large muscle groups, and it often results in localized abscess formation. Although relatively uncommon in more temperate areas, such as North America, pyomyositis accounts for up to 4% of surgical admissions in some tropical areas. This geographic distribution has led to the alternative name of pyomyositis tropicans. Within North America, the highest incidence of pyomyositis is in the southernmost regions. In children, the peak incidence seems to occur between 5 and 9 years of age.

Pyomyositis most commonly affects the quadriceps, gluteal, and iliopsoas muscles. Other affected areas include the paraspinal, psoas, shoulder girdle, extremities (e.g., gastrocnemius), chest wall, and abdominal wall. Patients with psoas muscle involvement may present with limp, hip pain, or back pain. Multiple sites are involved in 11% to 43% of patients.

The type of infecting organism for osteoarticular infections depends on the age of the child and underlying medical problem. Staphylococcus aureus is the most common cause of osteomyelitis in all age groups, accounting for 70% to 90% of infections, perhaps because of its capacity to express bacterial adhesions that promote attachment to extracellular bone matrix. This organism also is able to evade host defenses, attack host cells, and colonize bone persistently. However, 20 to 70% of cases may be culture negative despite collection of blood, joint fluid, and bone for culture.

Since the initiation of the use of penicillin in the early 1940s, methicillin resistance has become increasingly common among strains of S. aureus (MRSA), however methicillin sensitive Staphylococcus aureus is still the most common organism. Two studies recently addressed changes in the epidemiology of musculoskeletal infections associated with MRSA in children, documenting an increase in the number of cases caused by MRSA. Other studies have shown increasing complications such as deep venous thrombosis (DVT) and septic thrombophlebitis associated with musculoskeletal infection concurrent with a rise in the incidence of MRSA as a causative organism. Goergens et al have reported a higher incidence of surgical intervention and a greater number of subperiosteal and intraosseous abscesses associated with MRSA.

Initially methicillin resistance staphylococcus aureus (MRSA) were used to be seen only in hospital settings and were called as health-care-associated MRSA (HA-MRSA). Several risk factors including frequent contact with the healthcare environment, presence of a central venous catheter or tracheostomy, prolonged hospitalization, hospitalization before onset of the infection, number of surgical procedures done, and receipt of antimicrobials in the previous 60 days have been linked with infections caused by HA-MRSA. However in late 90s, incidence of osteoarticular infections with MRSA without these risk factors began to rise and these strains were labelled as community-associated MRSA (CA-MRSA). CA-MRSA has emerged as an increasingly prevalent cause of osteoarticular infections in children. Some studies have linked some risk factors like young age, family members with CA-MRSA, frequent antibiotic exposure, child-care attendance, and the presence of furuncles to the increased prevalence of CA-MRSA.

Besides Staphylococcus aureus, in neonates, infections with gram-negative organisms and Group B Streptococcus are common. Streptococcal pyogenes causes approximately 10% of cases of acute hematogenous osteomyelitis with a peak incidence of disease in preschool-age and early school-age children. Children with S. pyogenes osteomyelitis often have a recent history of varicella infection and present with higher fever and white blood cell (WBC) counts compared with children infected with S. aureus. Children with osteomyelitis caused by S. pneumoniae are younger than children infected with S. aureus and S. pyogenes. They are more likely to have joint involvement.

The incidence of Haemophilus influenzae as a pathogen in children under four years is decreasing with the use of vaccination against H. influenzae B. Since this decline in H. influenzae osteomyelitis and septic arthritis in children under the age of 3 years, there has been an increasing prevalence of gram negative organisms such as Kingella kingae. Kingella kingae has been recognized as an increasingly important cause of musculoskeletal infections in children in the last 2 decades. Osteoarticular infection by K. kingae usually manifests as osteomyelitis or acute mono-articular septic arthritis in young children. K. kingae is thought to account for up to 50% of cases of septic arthritis in children less than 2 years old in whom no causative organism is identified. K. kingae is a fastidious gram-negative coccobacillary bacteria found in normal respiratory flora. Infection with this organism often is
preceded by an upper respiratory tract infection or stomatitis; disrupted respiratory mucosa may facilitate invasion and hematogenous dissemination. Clinical onset of septic arthritis caused by K. kingae tends to be acute, often presenting with fever and most often in children less than 4 years old. K. kingae osteomyelitis is often insidious in its presentation, resulting in diagnosis after 1 week or more in 70% of patients.  

Puncture wounds to the foot may result in osteomyelitis caused by mixed flora, including Pseudomonas, S. aureus, enteric gram-negative bacteria, and anaerobes. A series of cases describes osteomyelitis of the metatarsals occurring as a result of toothpick puncture injuries. The organisms isolated included skin and environmental organisms; others have reported infection with mouth organisms as a result of toothpick injuries.  

Anaerobes are a rare cause of pyogenic osteomyelitis in healthy children. Predominant organisms are Bacteroides, Fusobacterium, Clostridium, and Peptostreptococcus. Anaerobic osteomyelitis can occur as the result of a bite, chronic sinusitis, mastoiditis, or dental infection. Organisms causing bone infection in children with sickle cell disease include Salmonella and S. aureus and less commonly Escherichia coli, Shigella, and S. pneumoniae. Unusual causes of osteomyelitis include infection with Mycobacterium, Bartonella, Coxiella burnetii, or fungi.  

Patients with sickle cell disease have been documented to be particularly susceptible to osteoarticular infections. Osteomyelitis and septic arthritis are two of the infectious complications of sickle cell disease. The peculiar association of sickle cell anemia with Salmonella species osteomyelitis was documented by Carrington et al in 1925 and subsequently confirmed by many authors. Seventy-five percent of osteoarticular infections in children without sickle cell disease have been attributed to Staphylococcus species. This is in contrast to osteomyelitis in children with sickle cell disease in which Salmonella species has been implicated in 60-80% of cases.  

The successful management of pyogenic arthritis depends on institution of appropriate antibiotic therapy and timely decompression of the lesion if required. The length of antibiotic treatment for osteomyelitis is largely empiric and recommendations have been evolved based on clinical experience. A total of three to four weeks of antibiotics is agreed to be the minimum length of treatment required for uncomplicated osteomyelitis that has not required surgical intervention. Antibiotic treatment should be continued orally for a total of 3-4 weeks, as an antibiotic duration of less than 3 weeks is associated with increased recurrence rate. Most children who receive appropriate therapy for osteomyelitis have no long-term sequale. Recurrence of infection occurs in approximately 5% of cases. Risk factors for development of complications include delay in diagnosis, short duration of therapy, and young age at the time of initial illness. The reported incidence of sequelae in neonates with osteomyelitis ranges from 6% to 50%.  

OSTEOARTICULAR TUBERCULOSIS

A number of studies have been published on the epidemiological aspects of TB in the past decade. Most of these studies focus on national trends and adult populations, but not much is known about the TB burden in children. TB continues to be a major cause of morbidity and mortality worldwide with estimates that one third of the world's population is latently infected with Mycobacterium tuberculosis. The incidence and prevalence of pediatric tuberculosis (TB) worldwide varies significantly according to the burden of the disease in different countries. It has been estimated that 3.1 million children under 15 years of age are infected with TB worldwide. According to the World Health Organization (WHO), children with TB represent 10 % to 20 % of all TB cases. The majority of these cases occur in low income countries where the prevalence of Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome (HIV/AIDS) is high. TB occurs frequently among disadvantaged populations, such as malnourished individuals, and those living in crowded areas. According to WHO reports, India, China, Pakistan, the Philippines, Thailand, Indonesia, Bangladesh, and the Democratic Republic of the Congo account for nearly 75 % of all cases of pediatric TB.  

In high human immunodeficiency virus (HIV) prevalent settings, children (both infected and affected) are at high risk of TB infection due to close proximity with young adults who are most likely to be HIV-infected and in whom TB is the commonest opportunistic infection. Further, due to the high prevalence of other opportunistic infections among HIV infected children and the lack of a gold standard, diagnosis of TB is often a challenge in this population. The deadly synergy of human immunodeficiency virus (HIV) and TB and the emergence of multi drug-resistant M. tuberculosis have further complicated TB control. Despite the existence of a government-run TB control programme in India, the current nationwide burden of TB continues to grow due to several factors, including the impact of the HIV epidemic, the aging of the population and ignorance and negligence by the patients.  

According to WHO, November 2010, one third of the
world's population is infected with the TB bacillus. The incidence of new TB cases in 2009, was 9.4 million with 14 million prevalent cases, most of which occurred in the South-East Asia region. The overall occurrence of extra-pulmonary tuberculosis in children is unknown; however, it is quoted to be between 5% to 10% in children younger than 5 years, of which half of them occur in the spine. Clinical and radiographic presentations vary widely and depend upon the stage of the disease at the time of diagnosis. Skeletal TB may remain unrecognized for months to years because of its lack of specific signs and symptoms and indolent nature.

Vertebral tuberculosis is the most common form of skeletal tuberculosis, accounting for 50% of all cases in reported series. Approximate distribution in the spine is: hip (50%), knee (20%), ankle and foot (5%), hand and wrist (3%), elbow (2%), shoulder (1%), bursal sheaths and other bones (8%).39,50

**SUMMARY**

To summarize, a systematic approach to osteoarticular infections with appropriate physical examination, laboratory and radiographic studies combined with clinical correlation and close observation is required to arrive at an appropriate diagnosis. Tuberculosis should always be considered as a differential, especially in endemic countries. Early and aggressive medical and surgical treatment maximizes the potential for a satisfactory outcome. The potential for change in the epidemiology of musculoskeletal infection within a given community suggests that a periodic review may be beneficial to ensure that the current methods of evaluation and treatment are aligned with the current manifestations of the disease.

**REFERENCES**

Paediatric osteoarticular infections


○ ○ ○