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Review Article

The entirety of paediatric osteoarticular infections

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ABSTRACT

Bone and joint infections are the important cause of morbidity and mortality in children which results in deformities and affects motor development of the child. In paediatric practice, early diagnosis and treatment of osteoarticular infections is very important to prevent morbidity and mortality. The main objective of this article is to understand the clinical, diagnostic and therapeutic profile of paediatric osteoarticular infections, which will help in having a basic framework and algorithm for early diagnosis and appropriate management which decreases the morbidity and mortality associated with osteoarticular infections.

Keywords: Osteoarticular infections, Septic arthritis, Osteomyelitis, Paediatric, Arthroscopy

INTRODUCTION

Paediatric osteoarticular infections include osteomyelitis, septic arthritis and a combination of both. The incidence of osteomyelitis varies between 1 and 13/1 lakh children/year[1] in developed countries to 200/1 lakh children/year in low- and middle-income countries and incidence rates of septic arthritis are reported as 4–37/1 lakh population.[2] 1% of paediatric hospital admissions are due to bone and joint infections.[1] Early diagnosis and treatment play a key role in achieving better outcomes and preventing sequelae leading to disabilities. It is important to understand the clinical and diagnostic profile of paediatric osteoarticular infections to know changing trends in every aspect of management as well as to know the significance of laboratory and radiological investigations which will act as a catalyst for early diagnosis and treatment.

CLASSIFICATION

Paediatric osteoarticular infections are classified into:[3]

1. Osteomyelitis
2. Septic arthritis
3. Combination of both.

PREDISPOSING/RISK FACTORS

The following are the probable associations described in osteoarticular infections:

1. Upper respiratory tract infection – *Kingella kingae*
2. Trauma, blunt injury and varicella infections – group A streptococcus
3. Sickle cell anaemia – Salmonella species
4. 4, Immunodeficiency – Serratia, Aspergillus
5. Penetrating wounds – Pseudomonas and anaerobes
6. Animal handling and laboratory work – *Brucella*, *Coxiella*

7. Contact with pulmonary tuberculosis – *Mycobacterium tuberculosis*
8. Prematurity, central venous lines and bacteraemia.

AETIOLOGY

The most common etiological agents of bone and joint infections are tabulated below in Table 1.[3]

Pathophysiology

Osteomyelitis affects bone and its medullary cavity. Bone is resistant to infection unless it is subjected to trauma, disruption of blood flow that deprives the bone of normal host immunity, a large inoculum of blood-borne or external microorganisms or a foreign body.[4] Haematogenous inoculation usually starts in the metaphysis, wherein the blood flow is slow in the sinusoidal blood vessels. Inflammatory cells migrate to the area, leading to oedema, vascular congestion and small vessel thrombosis, leading to an increase in intraosseous pressure resulting in impaired blood supply to the medullary canal and periosteum leading to the formation of sequestrum (necrotic bone). Bony tissue attempts to compensate for the tensile stresses caused by infection by creating new bone around the areas of necrosis. This new bone deposition is called an involucrum. Anatomic distribution of osteoarticular infections is shown in Figure 1.[5]

Septic arthritis is usually a consequence of haematogenous spread or direct inoculation into the joint. The lack of a basement membrane makes the highly vascular synovium vulnerable to bacterial seeding. From synovium, infection reaches articular cartilage, leading to increased production of synovial fluid, causing joint effusion leading to ischaemic damage of the cartilage.[2]

Clinical features of bone and joint infection in children

The clinical features of bone and joint infections[3] are tabulated in Table 2. The management of bone and joint infections[3] is tabulated in Table 3. The choice of empirical IV antibiotics[3] is tabulated in Table 4.

Table 1: Etiological agents in bone and joint infections.

Age	Aetiological agent
<3 months	*Staphylococcus aureus* *Escherichia coli* and gram-negative bacteria Group B streptococcus *Candida albicans* *Neisseria gonorrhoea* (neonate)
3 months–5 years	*Staphylococcus aureus* *Kingella kingae* Group A streptococcus *Hemophilus influenza* b *Streptococcus pneumoniae*
Older child >5-year old	*Neisseria gonorrhoea* *Staphylococcus aureus* *Streptococcus pneumoniae*

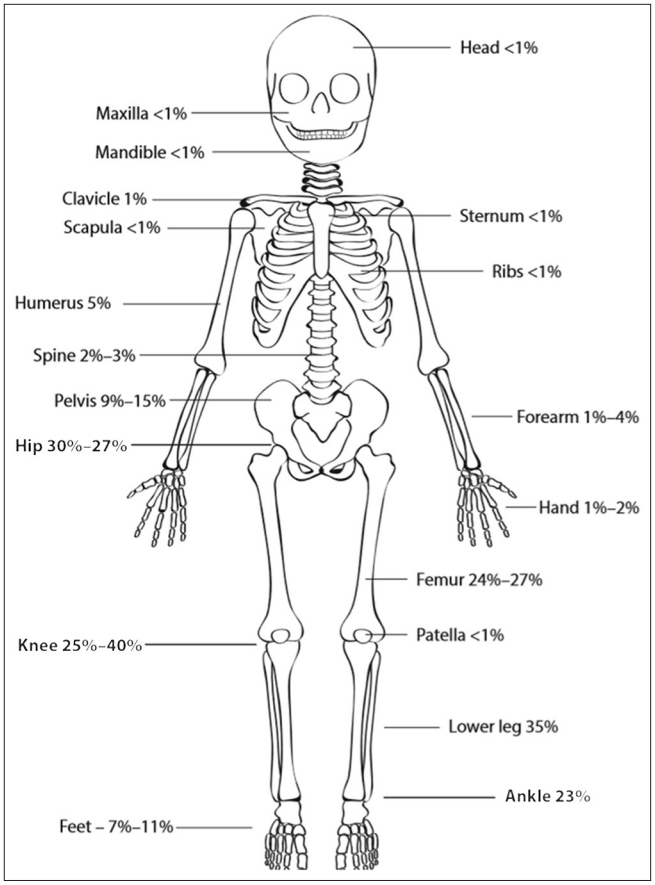

Figure 1: Anatomic distribution of osteoarticular infections.

Surgical interventions

Include: Arthrotomy, arthroscopy, arthrocentesis and lavage – chosen based on institutional expertise and clinical condition.[3]

Complications/sequelae

1. Limping, deformity, pyomyositis, chronic pain, rigidity and chronic
2. Recommended follow-up intervals with paediatrician and orthopaedic surgeons post-discharge are as follows: 2 weeks, 6 weeks, 3 months, and 12 months after discharge
3. Pain-free normal activity is the end point to end follow-up.

Physical therapy

1. Support and protection devices such as removable cast and boot case depend on the site and severity of bone and joint infections. Instructions are given to avoid weight-bearing and encourage passive movements to prevent rigidity.

Table 2: Clinical features of osteoarticular infections in children

	Age	Symptoms	Local symptoms
OM	<30 days	Fever Irritability/ excessive cry Poor feeding Nonspecific symptoms	Limb pain Local inflammation Pseudoparalysis If flat bones are involved, no localising signs are found
OM	1 month to 2 years	Vomiting, poor feeding, irritability Fever Severe systemic symptoms due to bacteraemia	Refusal to bear weight Limping Local inflammation
	2 year–18 years		Limp Pain Swelling Erythema Older children tend to localise
SA	0–18 years		Hot, swollen, immobile peripheral joint Pain on passive joint movement

OM: Osteomyelitis, SA: Septic arthritis

Table 3: Management of osteoarticular infections

	Uncomplicated OM/SA	Complicated OM/SA
1. Hospitalisation	Yes	Yes
2. Blood tests	CRP, ESR, CBC	ESR, CRP, CBC
3. Bacteriology	Blood Culture: 4 mL in children and 2 mL in neonates: Blood, synovial fluid or bone/tissue sample Consider PCR	Blood Culture: 4 mL in children and 2 mL in neonates: Blood, synovial fluid or bone/tissue sample Consider PCR
4. Imaging	Osteomyelitis - X-ray, MRI Septic arthritis - USG, MRI (to document any evidence of osteomyelitis)	Osteomyelitis - X-ray, MRI Septic arthritis - USG, MRI; (to document any evidence of osteomyelitis). Bone scan if MRI is not available
5. Surgery	Indications: Effusion, pus, bone destruction and lack of clinical response	Indications: Effusion, pus, bone destruction and lack of clinical response
6. Antibiotic treatment	Discussed separately	
7. Monitoring	When pathogen is not known	Consider 2nd line or additional antibiotics if gram negative and MRSA are not ruled out.
8. IV to oral switch	Clinical improvement in pain mobility and swelling Afebrile for 24–48 h Decreased CRP (30–50% of highest value)	Minimum of 1 week of IV therapy and same factors to be considered for switch
Up to 3 months of age	Switch after 14–21 days Duration of treatment - 4–6 weeks (for both OM and SA)	Switch after 21 days Duration of treatment - 4–6 weeks (for both OM and SA)
3 months of age – time to switch and duration	Switch after 24–48 h of clinical improvement Total duration: OM: 3–4 weeks (MRSA –6 weeks) SA: 2–3 weeks	2 weeks of IV antibiotics and then switch to oral to cover the total duration of treatment of 4–6 weeks (for both OM and SA)
9. Follow-up	CRP Longer follow-up is required in infants and complicated infections. Follow-up imaging (USG/MRI) may be required.	End point of therapy is difficult to determine in complicated infections which can be based on normal CRP and improvement in symptoms Follow-up with the orthopaedic surgeon to address on-going sequelae.

CRP: C-reactive protein, CBC: Complete blood count, ESR: Erythrocyte sedimentation rate, USG: Ultrasound, MRI: Magnetic resonance imaging, PCR: Polymerase chain reaction, OM: Osteomyelitis, SA: Septic arthritis, MRSA: Methicillin resistant staphylococcus aureus

Table 4: Choice of empirical IV antibiotics

Age	Empirical IV antibiotic treatment
<3 months	Cefazolin and gentamicin (alternative – ASP + cefotaxime)
3 months–5 years	Cefuroxime/cefazolin, in non Kingella regions – add clindamycin; Alternatives: Ceftriaxone or ASP or amoxicillin-clavulanate or ampicillin-sulbactam
>5 years	Cefazolin or ASP or clindamycin (high MRSA prevalence)

MRSA: Methicillin resistant staphylococcus aureus, ASP: Antistaphylococcal penicillin.

2. Management of bone and joint infections is by a multidisciplinary approach which includes a team of paediatrician, paediatric orthopaedic surgeons, paediatric infectious disease specialists and rehabilitation.

CONCLUSION

Paediatric osteoarticular infections always pose diagnostic challenges due to their non-specific clinical presentation. Due to the non-availability of 'gold standard' diagnostic tests, many diagnostic algorithms were proposed which were never a substitute for clinical decision-making. Recommendations in the literature are based on expert opinions, case series and descriptive studies. There is a need for large multicentric randomised controlled trials and prospective studies for better understanding of paediatric osteoarticular infections to decrease morbidity and mortality.

Ethical approval

Institutional Review Board approval is not required.

Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Conflicts of interest

Dr. Bhaskar Shenoy is on the editorial board of the Journal.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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