LRI Emergency Department and Children's Hospital

Acute bone and joint infections in children

Staff relevant to:	Medical & Nursing staff working within the UHL Children's Hospital.
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Reviewed by:	Khuen Foong Ng, Srini Bandi
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Contents

1. Introduction and who this guideline applies to

The incidence of paediatric bone and joint infections (BJI) in UK is 1.4-11/100,000 each year. Osteomyelitis (OM) is more common than septic arthritis (SA). BJI is more prevalent in boys than girls.

Most BJI in children are results of haematogenous spread. Other modes of infection are by local invasion of bacteria after trauma and presence of prosthetic material. The following situations/risk groups have been associated with BJI

- Preceding trauma
- Presence of prosthetic material
- Sickle cell disease (*Salmonella* spp.)
- Immunodeficiency e.g. Chronic Granulomatous Disease (*Serratia, Aspergillus*)

This guideline is for Clinicians and Health Professionals assessing and managing children under 16 years old with suspected or proven acute bone and joint infections. Management recurrent or chronic BJI and investigation for immunodeficiency syndromes are beyond the remit of this guideline.

Aetiology

The most common bacterial cause of OM and SA is *Staphylococcus aureus* followed by Group A *streptococcus* (GAS). The incidence of different bacterial aetiology of BJI depends on age group (Table1), background risk factors and geographical region. Other bacteria which are implicated are *Pseudomonas, Salmonella* and methicillin resistant *S. aureus* (MRSA) especially if patients had history of travelling to area with high MRSA prevalence.

Table 1: Most common pathogens according to age in acute BJI

Age	Pathogen
<3 months	*S. aureus* *Escherichia coli* and other Gram-negative bacteria Group B *Streptococcus* *Candida albicans* *Neisseria gonorrhoeae* (newborns)
3 months – 5 years	*S. aureus* GAS *Streptococcus pneumoniae* (especially under 2 yr old) *Haemophilus influenzae* type b (Uncommon in immunised children) *Kingella kingae*
>5 years	*S. aureus* GAS *N. gonorrhoeae* (in sexually active adolescents)

2. Clinical assessment and Investigations

Paediatric BJI may present as acute OM, SA, OM-SA, pyomyositis or spondylodiscitis (uncommon). Pyomyositis could be a complication of BJI, accompanying feature of BJI or primary infection without BJI.

Acute BJI is defined by duration of symptoms <2 weeks and subacute BJI 2 weeks to 3 months. Systemic symptoms that might be present are fever, irritability, poor feeding and vomiting. Most commonly the long bones and joints of the lower limbs are involved. Multifocal OM is seen in 5%–10% of infants (especially newborns and young infants). Pain in OM tends to be more localized. Tenderness, redness and swelling are more common in SA. Pyomyositis, when it involves muscles around the hip joint, can mimic SA.

The current approach is to favour an early MRI for hip symptoms if a hip pain/ restriction of movement is associated with a CRP > 20. This is based on a study from Peterborough which showed 85% sensitivity for joint infection, myositis or joint inflammatory disorder. Hip assessment is more challenging than knee, ankle, wrist, elbow and shoulder for which clinical exam and bloods usually suffice for decision making. Hence an early recourse to imaging for hip presentations is needed.

Table 2: Clinical features by age and site of BJI

BJI	Local symptoms
OM	In young child/infant May not have local signs, especially when flat bones affected Widespread limb pain difficult to localize on examination Pseudoparalysis Bone or limb swelling Erythema Refusal to bear weight or sit down Limping Older children tend to localize pain
SA	Hot, swollen, immobile peripheral joint Refusal to bear weight Pain on passive joint movement
Spondylodiscitis	Insidious onset back pain Refusal to sit, stand, walk or limping Refusal to flex the spine Constipation or abdominal pain Loss of lordosis, local tenderness or paraspinal muscle spasm Rarely neurologic signs
Pyomyositis	Refusal to bear weight Limping Bone or limb swelling Abdominal pain around psoas and pelvic muscles Localized pain

Table 3: Distribution of BJI infection in children

BJI sites		Percentage
Bone	Femur	20-30
	Tibia	19-26
	Humerus	5-13
	Pelvis	3-14
	Calcaneus	4-11
	Fibula	4-10
	Radius	1-4
	Clavicle	1-3
	Metatarsal, hand, ulna, metacarpal, spondylodiscitis	1-2
	Mandible, sternum, ribs, skull, maxilla, scapula, patella, talus	<1
Joints	Knee	35-56
	Hip	25-30
	Ankle	12-15
	Elbow	5-10
	Shoulder	4-5

Investigations

Table 4: Investigations recommended for BJI in children

Tests		Notes
Blood tests	FBC	Useful for differential diagnosis e.g. leukaemia
	CRP	Highly sensitive
	Blood culture	Should always be obtained despite low yield (10-40%).
Gram stain, culture	Synovial fluid	**Should be obtained before antibiotic initiation**. A positive gram stain helps in antibiotic choice. Drainage of purulent collection aids treatment.
	Bone sample	Not routinely required. Consider if there is subperiosteal pus and/or patient is not improving. Important in identifying non-infectious cause.
Imaging	X-ray	Always perform at baseline. For reimaging comparison and to rule out other diseases. • Acute OM: Frequently normal at baseline. Repeat imaging 10-21 days from symptom onset shows appearance of osteolytic changes or periosteal elevation • Subacute OM: Changes frequently seen can be confused with malignancies • SA: Limited usefulness; soft tissue swelling • Discitis: Lateral spine radiographs show late changes at 2–3 weeks into illness, eg decreased intervertebral space, erosion of vertebral plate. • Vertebral OM: Initially shows localized rarefication (thinning) of a single vertebral body, then anterior bone destruction.
	US	Very sensitive to identify joint effusion in SA
	MRI	Indicated for OM, spondylodiscitis and pyomyositis. Can detect abnormalities within 3-5 days from disease onset. Excellent for definition of soft tissue and bone marrow, identification of abscess, sequestra, pyomyositis, venous thrombosis.

Management

Initial management can include prompt empirical intravenous (IV) antibiotic therapy but early surgical referral for pus drainage and specimen collection for microbiology tests must be routine if BJI is being treated. The choice of empiric antimicrobial therapy is based on the most likely causative pathogens according to patient age, immunisation status, underlying disease, microbiology results, and other clinical and epidemiologic considerations, including prevalence of MRSA. A summary of management in children with suspected BJI is shown in the Appendix 1.

Antibiotic choice

Table 5: Empirical intravenous antibiotic therapy according to age group.

Age	Empirical IV antibiotic therapy (use high dose as per BNFc)
<3 months	IV Cefotaxime or Ceftriaxone
≥ 3 months – 5 years	IV Cefuroxime
≥6 years	IV Flucloxacillin*
Patients with sickle cell disease suspected to have BJI should receive • IV Ceftriaxone	

*Use vancomycin instead of flucloxacillin if known case of Methicillin Resistant *Staphylococcus aureus* (MRSA) or penicillin allergic.

In non-anaphylactic reactions to penicillin, continue to use cephalosporins. If there is a history of anaphylactic reaction discuss with microbiology.
Targeted antimicrobial therapy should later be tailored to the microbiological aetiology identified.

Switch from IV to oral antibiotic **(see table below for 'Complex disease')**

Switching from IV to oral antibiotic can be considered if:

- Afebrile for at least 48 hours
- Improvement of symptoms, with decreased inflammation and pain
- CRP < 20 or reduced by 2/3 of the highest value
- No signs of complications, such as metastatic foci (endocarditis, pneumonia, etc.) or deep vein thrombosis (DVT)
- Negative blood cultures if initially positive

	Total duration
Unifocal disease - disease indicates "simple" disease at a single site	3 weeks in Septic Arthritis 4 weeks in Osteomyelitis
Complex disease disease includes multifocal, significant bone destruction, resistant or unusual pathogen, immunosuppression, sepsis or shock or associated with metal work	IV to oral switch after 14 days; may require >6 weeks of treatment

Antibiotic duration and choice of oral antibiotic (step down)should be a joint decision between orthopaedics, microbiology and paediatrics.

Before stopping treatment, patient should be asymptomatic and the CRP should be normal (e.g., <5 mg/dL). Consider re-imaging if there is no clinical or laboratory improvement on antibiotics.

Surgical intervention

Referral to paediatric orthopaedic surgeon should be done from outset.

Joint drainage and irrigation is indicated in septic arthritis at the earliest opportunity.

Consider surgical intervention in the following situations

- Involvement of a joint
- Persistence of fever >72–96 hours or its reappearance
- CRP elevation
- Large size and position of the abscess, such as in close proximity to a growth plate
- Sequestration, periosteal abscess or other suspected complications
- Identification of MRSA
- Chronic OM or presence of prosthetic material

Physical therapy

Injury to the area of infection should be avoided but prompt mobilisation is just as crucial to prevent complications such as rigidity. Protective support device may be useful in the prevention of pathological fracture in certain OM depending on site and severity of disease. Pain control can be achieved by avoidance of non-weight-bearing. In case of spondylodiscitis, application of corset may be helpful.

Complications

1. Chronic infection
2. Relapse
3. Reinfection with different bacterial agent
4. Abscess or sequestrum
5. Residual pain and rigidity
6. Bone deformity
7. DVT

Follow up

Follow up with orthopaedic surgeon and paediatrician is recommended at about 2 weeks, 4–6 weeks, 3 months and 12 months after discharge. Consider longer follow-up in children with complex disease, involvement of the pelvis, the spinal column and hip, or if the physis is affected, especially infants and younger children. During follow up, clinical symptoms should be sought, perform periodic CRP and consider radiological investigations if indicated. There is no need to repeat CRP if it has normalised unless there is recurrence of symptom. Pain-free normal activity is an important end-point before discharge from follow-up.

3. Education and Training

No further training is required to implement this guideline.

4. Monitoring and Audit Criteria

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Timely investigation and management	Clinical audit	Dr Srini Bandi	3 yearly	Local departmental audit group

5. Supporting Documents and Key References

1. Saavedra-Lozano J, Falup-Pecurariu O, Faust SN, Girschick H, Hartwig N, Kaplan S, Lorrot M, Mantadakis E, Peltola H, Rojo P, Zaoutis T, LeMair A. Bone and Joint Infections. Pediatr Infect Dis J. 2017 Aug;36(8):788-799.
2. Mitchell PD, Viswanath A, Obi N, Littlewood A, Latimer M. A prospective study of screening for musculoskeletal pathology in the child with a limp or pseudoparalysis using erythrocyte sedimentation rate, C-reactive protein and MRI. J Child Orthop. 2018 Aug 1;12(4):398-405.
3. Antimicrobial Paediatric Summary https://uk-pas.co.uk/Antimicrobial-Paediatric-Summary-UKPAS.pdf (accessed 31 May 2022)

6. Key Words

Osteomyelitis, Septic Arthritis

The Trust recognises the diversity of the local community it serves. Our aim therefore is to provide a safe environment free from discrimination and treat all individuals fairly with dignity and appropriately according to their needs.
As part of its development, this policy and its impact on equality have been reviewed and no detriment was identified.

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title) Khuen Foong Ng - Paediatric Registrar Srini Bandi – Paediatric Consultant	**Executive Lead** Chief Nurse
Details of Changes made during review: **Updated antibiotic table** **Added ABX duration table**	

Appendix 1: Management Pathway for BJI in Children