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How not to miss infective causes of hip pain in children

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Abstract

A referral from accident and emergency for a child with hip pain is a scenario commonly faced by orthopaedic juniors on call. The list of differentials is vast and can make assessment and diagnosis challenging, with severe consequences if diagnosis is delayed or missed.

Three common causes of paediatric hip pain are septic arthritis, transient synovitis and osteomyelitis. These can all present as a child with atraumatic hip pain, irritability, fever and refusal to weight bear. Differentiating between them can be challenging. A thorough history and examination, combined with appropriate investigations and imaging, is essential. Early diagnosis and prompt treatment are key to reducing irreversible secondary sequelae of joint destruction and long-term functional impairment.

Key words: Hip pain; Osteomyelitis; Painful limp; Septic arthritis; Transient synovitis

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Introduction

A referral from accident and emergency for a child with hip pain is a scenario commonly faced by orthopaedic junior doctors on call. The list of differentials is vast and can make assessment and diagnosis challenging, with severe consequences if diagnosis is delayed or missed (Table 1). This article focuses on three common causes of paediatric hip pain: septic arthritis, transient synovitis and osteomyelitis. These can typically present as a child with atraumatic hip pain, irritability, fever and with a limp or refusal to weight bear. It is also vital to be clear that sexually active adolescents may not be classed in the same group, as they are susceptible to sexually transmitted infections and syndromes such as Reiter's syndrome. Thus, when this article uses the term children this is specifically focusing on children and adolescents under 16 years of age who are not sexually active.

This article discusses the history, examination and investigations required to aid diagnosis and the management of each condition.

History

Taking a thorough history is vital in ensuring correct and prompt diagnosis. Start by asking about the onset of the pain – was it acute or has it got progressively worse over a period of time? Ask if there was any trauma. Has the child felt unwell? Ask whether the child has been feeding normally. Has the child had a fever at home? Have they had a recent viral illness?

Table 1. Differential diagnosis of paediatric hip pain

Trauma	Fracture, haemarthrosis
Inflammatory and infective	Reactive arthritis, juvenile idiopathic arthritis, idiopathic chondrolysis, appendicitis, psoas abscess, pyomyositis, urinary tract infection, Lyme disease, Kawasaki disease
Developmental	Perthe's disease, slipped capital femoral epiphysis, secondary avascular necrosis of the femoral head, subluxation in Down syndrome
Tumour	Osteoid osteomas, Ewing's sarcoma, leukaemia, sarcomas
Other	Gynaecological pathology, sickle cell, Gaucher's disease

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Have they recently been taking antibiotics which could be masking symptoms? If the child is of walking age, have they been limping, or if non-ambulatory, is the child hesitant to use the affected limb? Ask about a family history of hip problems. Check for congenital disease such as sickle cell, developmental conditions including dysplasia, as well as any comorbidities. Ask about previous injuries, surgery and neurological or inflammatory diseases. If the patient is an adolescent, take a sexual history with sensitivity, ensuring their dignity and privacy.

Examination

As usual, the look, feel, move approach to joint examination should be used. Always compare the side in question to the other side. Examine the gait if possible. Remember that knee and thigh pain can be referred from the hip and hip pain can be referred from the lumbar spine, sacroiliac joints, abdomen and testes, so these areas should be examined too.

Look

Look at the position of the leg. Look for erythema, deformity, scars, asymmetry and leg length. Swelling is difficult to see in the hip because of the depth of the joint.

Feel

Palpate the hip for tenderness and feel for warmth.

Move

First check the active range of movement. Children should be able to flex their hip to bring the knee to the chest (120°), extend their hip to 20°, abduct around 40–50° and adduct to 15°. Then gently assess the passive range of movement with the hip and knee flexed to 90°. Internal and external rotation should both be approximately 40–50° and the total rotation should roughly equal 90° (Sankar et al, 2012).

Septic arthritis of the hip

Septic arthritis is a surgical emergency, defined as an intra-articular infection. It is most commonly caused by *Staphylococcus aureus*, but association of certain organisms is also seen, such as group B Streptococcus in neonates, *Neisseria gonorrhoeae* in sexually active adolescents and Salmonella in sickle cell patients (Wang et al, 2003). Around 50% of all cases of septic arthritis of the hip occur in children less than 2 years old. The hip is the most commonly infected joint, closely followed by the knee (Shirtliff and Madar, 2002).

Infection within the synovial capsule results in the accumulation of pus. Pus contains chondrolytic enzymes, which lead to breakdown of the articular cartilage. Large volumes of pus also result in increased intra-articular pressure, which can lead to epiphyseal ischaemia. Prompt recognition and treatment is vital to avoid bony destruction, preserve hip function and avoid long-term disability.

Signs and symptoms

The hip pain will typically have an acute onset. The child will have a limp or completely refuse to weight bear. There will be systemic features such as fever, irritability and fatigue. The child will appear unwell.

Signs can include pyrexia, tachycardia, joint swelling (although this can be difficult to appreciate in the hip), tenderness and warmth. The hip is often in the FABER position (flexed, abducted and externally rotated; the position which gives maximum capsular volume) to relieve pain. There will be severe pain on passive range of movement and the child may be unwilling to perform active movement. Examine local joints to rule out adjacent joint involvement.

Investigations

Bloods

A white cell count, erythrocyte sedimentation rate and C-reactive protein should be requested. Kocher criteria are a set of four parameters which are used to estimate the probability of septic arthritis:

- White cell count >12 000 cells/mm^3
- Inability to weight bear
- Erythrocyte sedimentation rate >40 mm/hour
- Temperature over 38.5°C.

Each parameter scores one point. A score of zero has a predictability of 0.2% likelihood of septic arthritis, 1=3%, 2=40%, 3=93%, while a score of 4 has a likelihood of 99.6% (Kocher et al, 1999).

A modified version of this score uses a C-reactive protein level of >20 mg/litre instead of erythrocyte sedimentation rate (Singhal et al, 2011) as C-reactive protein is a better predictor of septic arthritis than erythrocyte sedimentation rate (Montgomery and Epps, 2017), but fever is the best predictor (Sultan and Hughes, 2010).

Joint aspiration

Send the sample for microscopy, culture and sensitivities. This will confirm the diagnosis with over 50 000 white blood cells per mm^3, organisms seen on microscopy or a positive culture. Joint fluid should be sent for 16S rDNA polymerase chain reaction test as this substantially improves the detection rate of pathogens and has a markedly improved rate of detecting *Kingella kingae* (Carter et al, 2016; Tkadlec et al, 2019).

Inform the microbiology technician and microbiology consultant that this is a suspected case of septic arthritis so the samples are prioritised.

Blood cultures

These should be taken before starting any antibiotics.

Imaging

Antero-posterior and frog-leg lateral radiographs are needed, which may be normal in the early stages. Signs include widening of the joint space, subluxation or dislocation. They will also help to rule out important differentials such as fracture, avascular necrosis, osteomyelitis or tumours (Figure 1).

Ultrasound can be used to identify effusion or help guide needle aspiration, but it cannot distinguish between septic and sterile effusion. It can often be helpful to image both hips to compare sides to aid diagnosis.

Magnetic resonance imaging can identify effusion and any adjacent osteomyelitis of the bone, but is often difficult to get quickly.

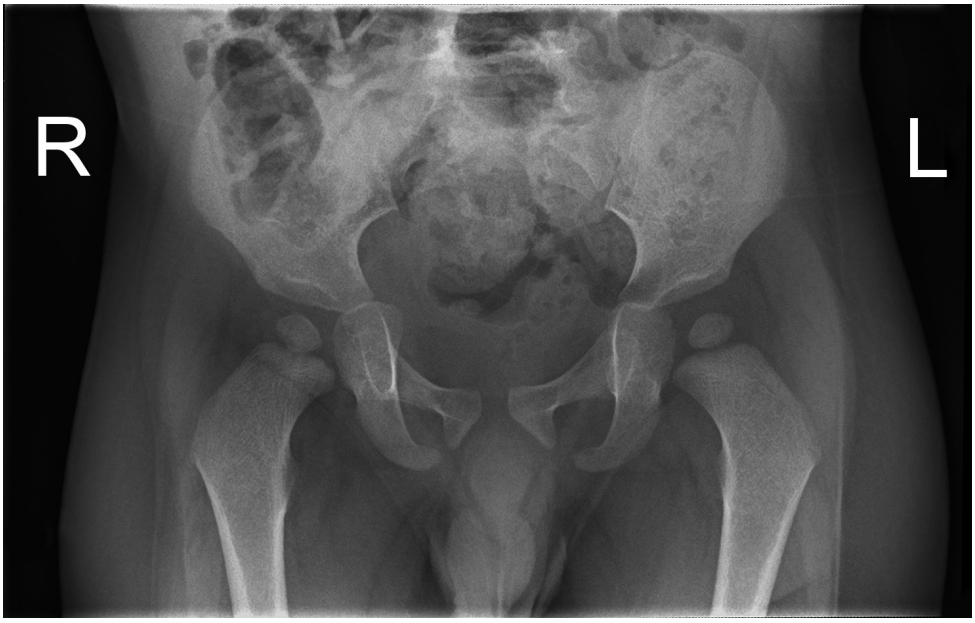

Figure 1. Radiograph showing left hip effusion.

Management

Involve seniors at an early stage. In children with a Kocher's score of 3 or 4 and no other source of infection, the diagnosis is septic arthritis until proven otherwise. The orthopaedic consultant in charge of the patient should be made aware urgently that this child might have septic arthritis. In those with lower scores, the diagnosis is more of a challenge. Even if there is only a clinical suspicion, most orthopaedic consultants would want to ensure they are aware of such a patient and should therefore be informed. If there is doubt in the diagnosis, in conjunction with orthopaedic consultant approval, image-guided aspiration of the hip should be considered, although a negative aspiration does not rule out infection. Regular clinical review, along with serial measurement of C-reactive protein levels, can help monitor for any improvement or further deterioration.

Once a diagnosis is made, the patient should be kept nil by mouth and preparations made to take the patient to theatre. Antibiotics should be held until joint fluid samples are obtained. If the patient is septic, antibiotics should be commenced immediately but ensure blood cultures have been taken first. The patient will need to undergo an urgent open washout with several litres of normal saline. The arthrotomy can be performed via an anterior, Smith–Peterson approach to the hip to avoid compromising the blood supply to the femoral head and damaging the hip abductors (Xu et al, 2016).

Surgical washout works in two ways: it reduces the bacterial load in the joint, allowing antibiotics to work more effectively, and it removes the pus, reducing the quantity of chondrolytic enzymes breaking down the joint surfaces.

Pus samples and synovial biopsies should be taken and sent for microscopy, culture and sensitivity and histology. A drain can be left in place for around 48 hours. The microbiology consultant on call should be made aware so that they can ensure that the microbiology technician urgently processes these samples so the patient's case can be prioritised, in order to urgently establish a bacterial diagnosis.

Once organisms and sensitivities are identified, antibiotics can be modified as appropriate. The patient needs to be monitored closely in the postoperative period. At this stage, most will begin to show clinical improvement but if symptoms persist, along with elevated levels of inflammatory markers and pyrexia, the patient may require a second washout. Ongoing clinical monitoring is essential to see the response to surgical treatment.

A long course of antibiotics will be needed to eliminate the infection. Duration can typically be 4–6 weeks but this can be extended based on clinical correlation and advice from the local microbiologist.

Transient synovitis

Transient synovitis is a benign self-limiting condition caused by inflammation of the synovium of the hip. It is the most common cause of hip pain in children and peaks between the ages of 3 and 10 years old, with a male to female ratio of 2:1 (Houghton, 2009). Its exact cause is unknown but it is thought to be related to other distant infections, trauma or allergic reactions. While it mimics much more severe conditions as mentioned previously, its diagnosis is one of exclusion.

Signs and symptoms

The child will likely be systemically well but may present with a mild fever. Groin or hip pain is usually not severe but is enough for the child to refuse to weight bear. The course typically tends to improve throughout the day. It is commonly associated with a preceding infection such as a cold or a sore throat.

The child may also present with the hip in the FABER position depending on the timing of onset. Abduction may be restricted. There may be minimal pain on passive movements with pain being worse at extremes of range.

Investigations

It is important to remember that transient synovitis is a diagnosis of exclusion. The most important differential in the acute setting is septic arthritis, so the Kocher criteria can be a very useful tool.

In terms of blood results, the white cell count may be slightly elevated, with C-reactive protein <20 mg/litre and erythrocyte sedimentation rate <20 mm/hour.

Radiographs may show joint space widening and ultrasound may show an effusion.

Management

Management is conservative with bed rest, non-steroidal anti-inflammatory drugs and close observation. Transient synovitis is a self-limiting condition and symptoms typically only last 24–48 hours, with complete resolution of symptoms within a week.

If the pain becomes more significant, the child starts to refuse to weight bear or a fever develops, it is important to re-evaluate the diagnosis.

The patient may be admitted if the clinical team is worried. If the patient is well enough to be discharged, make sure they are followed up sooner rather than later in the outpatient setting. Give clear advice to parents to bring the child back if there is any further deterioration.

Transient synovitis has no long-term sequelae but reoccurs in around 15% of patients, affecting the same or sometimes the opposite hip (Taylor and Clarke, 1995).

Osteomyelitis of the proximal femur and pelvis

Osteomyelitis is infection of the bone. The infecting organisms have two possible routes of spread to the bone: haematogenous, via the bloodstream, from infection elsewhere in the body; or direct (also known as contiguous), which is spread directly from wounds, trauma or during a surgical procedure. In children, the haematogenous route is most common (Peltola and Pääkkönen, 2014).

The metaphysis of the bone is the most common site of infection because it is highly vascularised. Most cases are caused by *Staphylococcus aureus* in infants and children, with group B streptococcus and coliforms being causative agents in neonates.

Infection results in the formation of pus. Pressure from the accumulation of pus under the periosteum separates it from the bone. This disrupts the cortical blood supply, which eventually leads to necrosis. Once a piece of necrotic bone becomes separated from the rest of the bone, it becomes known as sequestrum. Antibiotics are then of limited use and can only suppress the infection; they will not clear the infection unless the sequestrum is surgically debrided (Panteli and Giannoudis, 2017). Bone production around the elevated periosteum results in a new layer of bone, separate to the existing bone, called involucrum.

Sequelae of osteomyelitis include growth plate damage, pathological fractures, osteonecrosis and chronic osteomyelitis, and possibly septic arthritis.

Signs and symptoms

A child may present with a very similar picture to the conditions above. They may have a painful limp or inability to weight bear. They will usually have pain around the groin and thigh. They will have more systemic features, such as a fever or general malaise.

In immunocompromised patients and neonates, symptoms may be harder to detect and only picked up once the infection is at a more advanced stage.

Investigations

Blood results

White cell count is raised in only 35–40% of cases, C-reactive protein is raised in 98% of cases and erythrocyte sedimentation rate is >20 mm/hour in 70–90% of cases. Blood cultures will only be positive in 30–50% of cases (Huntley and Crawford, 2011). Again, inform the microbiology technician and microbiology consultant so that the samples are prioritised.

Imaging

Radiographs will be normal in the initial 7–10 days. After this, signs include periosteal elevation with underlying resorption and new bone formation.

Magnetic resonance imaging allows definition of soft tissue extension, intraosseous collections and joint involvement (Figure 2).

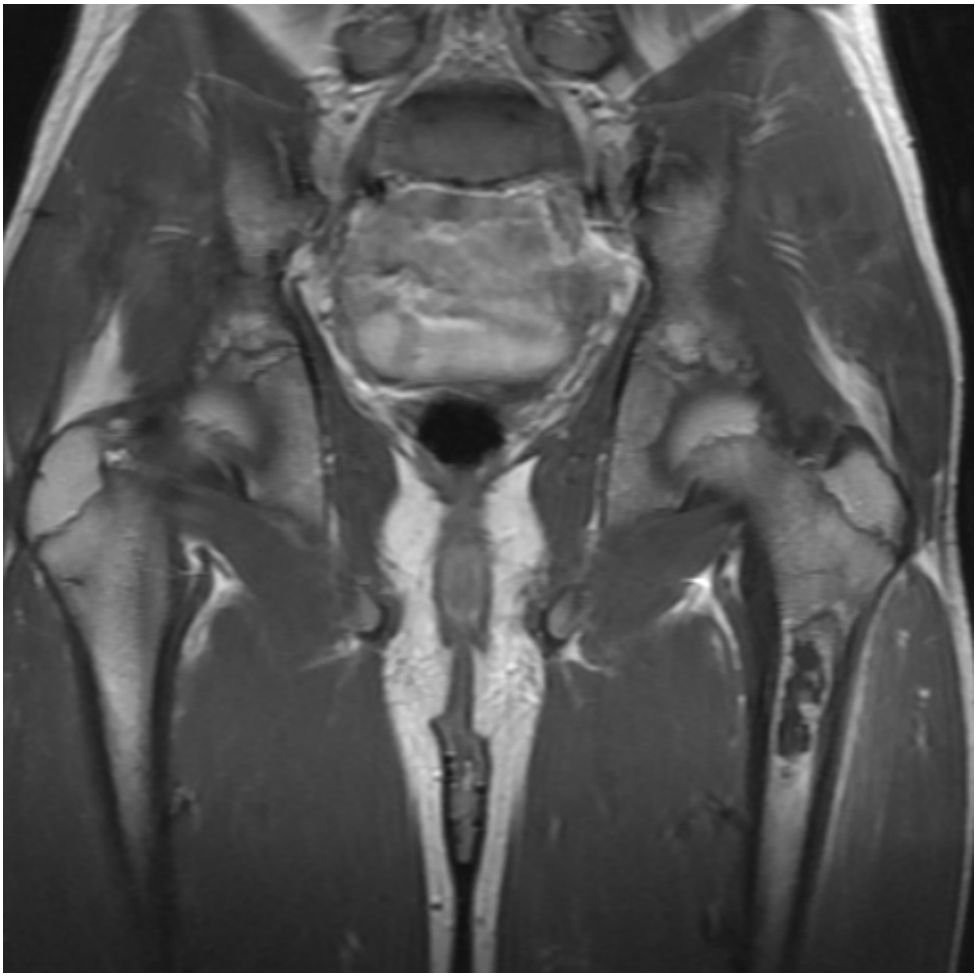

Figure 2. Magnetic resonance imaging showing osteomyelitis of the left proximal femur.

A white cell bone scan can be a useful adjunct in differentiating between infection and other related overactivity, for example as a result of a sickle cell crisis.

Bone aspiration and/or biopsy

This can be used to identify the infecting organism but usually requires sedation or a general anaesthetic, which may result in delayed treatment outside of tertiary centres.

Management

Prompt intravenous antibiotics are required to prevent sepsis and prevent secondary sequelae. Initial treatment should be empirical and converted to organism-specific therapy once organisms and sensitivities are identified. Just like septic arthritis, a microbiological diagnosis is essential as empirical treatment can hamper identification of the relevant pathogen and cause significant sequelae to the patient if they are treated with an inappropriate antibiotic agent.

The patient should be monitored closely and assessed for clinical improvement along with vital signs, hip range of movement and pain. Serial measurements of C-reactive protein levels should also be used alongside this to correlate response to antibiotics. If the patient is not improving as expected, they may require a repeat magnetic resonance imaging scan, change of antibiotics or even surgical intervention.

If pus is found on aspiration or an abscess is seen on magnetic resonance imaging, surgical debridement is required. Difficult to reach collections can sometimes be drained under radiological guidance by an interventional radiologist.

Duration of antibiotics can typically be 4–6 weeks but this can be extended based on clinical correlation and advice from the local microbiology department (Kavanagh et al, 2018).

Care pathway

The authors advocate that these patients should be under joint care of the paediatric and orthopaedic teams. This ensures that paediatric patients get optimum care, with the paediatricians ensuring that other systems have been checked thoroughly and no other site or foci of infections are undetected, leaving the patient suboptimally treated. Good communication and cooperation between teams is vital in order to ensure optimal care for the patients. This is the pathway in the authors' trust.

Conclusions

Early diagnosis and prompt treatment are key in reducing irreversible secondary sequelae of joint destruction and long-term functional impairment, especially in cases of septic arthritis. Differentiating between septic arthritis, transient synovitis and osteomyelitis can be challenging. A thorough history and examination, combined with appropriate investigations and imaging, is essential.

Careful consideration is required for immunocompromised patients or those who have had a recent course of antibiotics, both of which might mask symptoms, signs and/or test results. During assessment, keep in mind the wide range of differentials in order to not miss any of the rarer causes. It is also worth noting that one diagnosis does not exclude another. For example, in a child with metaphyseal osteomyelitis, transphyseal blood vessels can result in spread of infection to the epiphysis leading to septic arthritis, so it is important to be aware of any concomitant pathologies. If in doubt, keep the patient nil by mouth and discuss urgently with a senior colleague.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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Key points

- A child with a painful limp is a common presentation.
- Missed pathology can have serious consequences.
- A thorough history and examination is essential to aid diagnosis.
- Having a broad list of differentials in mind is key to ensuring nothing is missed.
- Early recognition and escalation to seniors is essential.

Curriculum checklist

This article addresses the following requirements from the Core Surgical Training 2017 ISCP syllabus:

- The clinical method in surgical practice
- Critical care
- Surgical care of the paediatric patient

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