

## ***Surgery in Africa - Monthly Review***

### **Acute Septic Arthritis and Osteomyelitis in Children – An African Perspective**

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## **1. Introduction**

Musculoskeletal infections are common reasons for African children to present for surgical care. For example, 43% of all children with musculoskeletal complaints presenting to a Togolese teaching hospital came with probable bone or joint sepsis (1). Septic arthritis of the hip is a surgical emergency, with prompt operative drainage a key requirement for reliable recovery. Early care with appropriate drainage of the bone or joint and antibiotic treatment can result in prompt recovery and minimum or no long term morbidity. Sadly, early drainage and uncomplicated recovery is the exception rather than the rule in reported African series. Over 60% of children with septic arthritis of the hip presenting to a district hospital in South Africa suffered complications and/or long term morbidity (2), and acute haematogenous osteomyelitis was the most common cause of chronic osteomyelitis among 107 Nigerian children (3). Population distribution and health care workforce in Africa mean that these conditions will present to General practitioners, paediatricians, herbalists(4)(2)and surgeons without orthopaedic specialty training. What is worse, they often present late(5)(4)(6)(2)(7)(8). Reasons for delay in treatment, inasmuch as they have been recorded in Africa, have less to do with distance, poverty, lack of maternal education, or care from traditional healers, and more to do with inappropriate early antibiotic management or incorrect primary diagnosis (2). Surgeons practicing in Africa, and their primary care colleagues, have the opportunity to prevent considerable lifelong disability from these common childhood afflictions.

## **2. Objectives:**

1. Epidemiology in Africa
2. Aetiology and pathogenesis
3. Diagnosis
4. Role and indications of operative management.
5. Role and duration of antibiotic management

## **3. Epidemiology**

There is a paucity of high-quality African epidemiological data upon which to base guidelines on the management of acute septic arthritis and osteomyelitis. Incidence data from a district hospital in Malawi serving a closed population yielded estimates of septic arthritis of 1:5000 per year for

children under 5 years and 1:13,000 per year for children in the 5-15 year group(9). Applying these rates to the 415 million children in the African population yields an estimates 41,500 children with joint infections every year. Similar or greater numbers of bone infections may occur every year, osteomyelitis is twice as common as septic arthritis in the West (10). Septic arthritis and osteomyelitis are likely more common in Sub-Saharan Africa because of poverty and its accompanying malnutrition and lack of resources. These conditions are therefore amenable to prevention through improving the status of children as well as to clinical diagnosis and cure.

Studies from Western countries have shown that the incidence of disease in the population changes over time, as can the bacteriological spectrum. Specifically, in the USA, Methicillin Resistant Staphylococcus Aureus is responsible for an increasing proportion of disease, and a 3-fold increasing prevalence of osteomyelitis(10). The increasing relative and absolute prevalence of MRSA disease is felt to be due to excessive and poor prescribing of antibiotics, and this may become an increasing problem in African populations where antibiotics can be easy to obtain.

## 4. Aetiology and Pathogenesis

Septic arthritis represents septic inflammation of the synovial lining of joints, and osteomyelitis represents same of bone and bone marrow.

### 4.1 Bacteriology

Staphylococcus Aureus is the most common causative agent for bone and joint infections worldwide and in Africa, but there are differences in the bacteriology reported according to geographic region, age of patient, and sickle cell status. A Nigerian series reported that staphylococcus aureus was responsible for 50% of joint infections in children, even among those with sickle disease (7). On the other hand, among children with septic arthritis in Malawi, salmonella was the most common causative organism even though only 3% of them had sickle disease (11). Many of the Malawi patients were anemic, malnourished, and exposed to malaria, all felt to be risk factors for gram negative sepsis. Understanding the local pattern in one's own hospital, and working with an infectious disease colleague, is the best way of determining the likely organisms and therefore the appropriate empirical antibiotic treatment.

In patients with sickle-cell anaemia, there is a geographical difference in the incidence of salmonella osteomyelitis. A review of fifteen studies of sickle cell osteomyelitis concluded that in Africa, staphylococcus aureus is responsible for 38.5% of cases, salmonella 21.4%, and other gram negative bacteria 34.2%. In the USA, salmonella is responsible for 70% of cases and staphylococcus aureus for only 16% (12).

Haemophilus influenzae is common in infants(13). Streptococcus, including group b, is common in neonates.

### 4.2 Pathogenesis

Musculoskeletal infection in children is usually by haematogenous spread from a remote septic focus, eg, ear and throat infections and skin infections from insect bites etc. Many times the primary source is subclinical or unknown. It may also be by direct spread from contiguous structures, eg a primary septic arthritis of knee causing a secondary acute osteomyelitis of proximal tibia and vice-versa, even though the latter is more common. It may occur from an open fracture or from direct inoculation from a joint puncture injury.

There are sadly some iatrogenic causes. Open reduction and internal fixation of fractures is one example. Sometimes in the emergency setting, femoral vessel puncture may be done for quick blood samples for investigations, and when strict asepsis is not ensured, there is a high risk of septic arthritis of the hip and acute osteomyelitis of the proximal femur. Again in the emergency setting, intra-osseous infusions and transfusions may be done as life saving measures, and this may inadvertently lead to infection(14). A definite history of either injection nearby or trauma to the joint was documented in 28% of cases of septic arthritis in Nigerian children (7).

Bone or joint trauma has been suggested as a predisposing factor, by producing either inflammatory changes or hematoma which make it easier for bacteria to evade normal host response mechanisms. An interesting hypothesis for the high prevalence of septic shoulders among Malawi infants is that the trauma of being swung by the arms to be carried on the back may be the predisposing factor (9,15).

Infection depends on host resistance and bacterial inoculum and virulence. In Africa, with a high rate of malnutrition, more children are prone to infection because of low immunity(14). HIV infection has not made it any better(16)(17).

### 4.3 Acute Osteomyelitis

The metaphyses of long bones are the commonest sites even though all parts can be affected(5). They have a rich blood supply. Hair-pin shaped vascular loops tend to slow down blood flow and this causes a drop in oxygen tension. This is because nutrition to the growth plate is by diffusion, and it necessarily requires slow flowing blood for this to be maximized. Following trauma around the metaphyses, haematoma is formed, and this further slows blood flow. The combination of rich blood supply plus stasis and the fact that blood is a good culture medium allows for bacterial multiplication and proliferation.

This sets up an acute inflammatory process in the medullary cavity. There is inflammatory oedema with consequent increase in the intra-osseous pressure. The increased intra-osseous pressure leads to tamponade of the endosteal blood vessels, thus depriving the bony cortex of some of its blood flow. Septic emboli and thrombosis develop in the endosteal vessels, leading to a further compromise to the cortical blood flow. As the medullary pressure continues to build up, the inflammatory exudate is forced through the porous cortex into the sub-periosteal space. This tracks proximally and distally under the periosteum, further denuding the bone of its blood supply. In some instances, the organisms are so virulent, the periosteum is completely destroyed. If there is no urgent intervention, there is necrosis of the bone and this necrosed bone is referred to as sequestrum. An attempt at formation of new bone known as involucrum is made, and when this occurs, it has changed from acute to chronic. The pus may track into an adjacent joint to cause a secondary septic arthritis.

### 4.4 Septic Arthritis

In septic arthritis, there is inflammation of the synovium, and this leads to septic joint effusion, and subsequent pus formation if untreated. The products of the inflammation include proteolytic enzymes arising from both bacterium and host which are thought to irreversibly destroy the cartilage. There is

increased intracapsular pressure, and this compromises blood supply, and consequently avascular necrosis and cartilage destruction. Joints with intracapsular epiphyses, such as the hip and shoulder, are more prone to avascular necrosis. Capsular distention also predisposes to joint dislocation, particularly dislocation of the hip in the neonate or young infant where the capsule is intrinsically more lax, and the acetabulum less developed.

## 5. Diagnosis

Ultimately, the diagnosis rests on the opinion of a clinician experienced in the assessment of musculoskeletal disease. Diagnosis is mainly clinical and supported by some investigations.

### 5.1 Clinical Findings

The child is ill and presents with a fever, bone pain and refusal to use the limb or bear weight. There is a history of trauma in 30% of cases. There may be a history of sickle-cell anaemia, or it may well be the first time the diagnosis is made. There may be evidence of a remote septic focus.

The limb and or joint are swollen, reddened in the light skin, tender, warm to touch and the child resists any attempt to move them. Joints are held in the position of maximum comfort, which is flexion, abduction, and external rotation of the hip, slight flexion of the knee, and abduction and internal rotation of the shoulder. These positions maximize capsular volume and minimize joint pressure. Pseudo paralysis of the extremity is common in infants and may be the only presenting sign, without marked local tenderness, swelling, or redness. Infants may also present with a dislocation of the hip due to capsular distension, and the 'clunk', of dislocation and reduction may be present in adduction and abduction respectively.

The absence of these classical signs and symptoms does not rule out the diagnosis because of the following reasons. It is easy to get access to antibiotics in Africa (6)(8) and some parents may have started some form antibiotic treatment on their own without proper advice. It is also possible that the patients have been partially treated with antibiotics because a wrong diagnosis has been made.

Septic arthritis affects upper limb joints more in neonates and infants, and the lower limb more in older children(14)(11) (8). This may reflect the common locations for antecedent trauma, which differ with age and activity. Osteomyelitis affects the humerus most commonly, then the femur, then the tibia, in children with sickle cell disease (18), whereas in children without sickle cell disease femoral and tibial sites are most common.

### 5.2 Laboratory Findings

There is leukocytosis with relative neutrophilia. The ESR is elevated; usually above 40mm/hr. C-reactive protein is also elevated. The haemoglobin may be low in the malnourished, sickle-cell patient and when there is intravascular haemolysis with the septicaemia. Blood culture has a positive yield of 40-50%. Three samples taken at the peaks of fever improve this yield. These investigations can be done in most laboratories in Africa.

Positive aspiration in the operating room, under general anaesthesia, strict asepsis and preferably image guided is diagnostic. A positive yield is expected in 60% of cases (9). When pus is aspirated, a formal drainage procedure can be carried out at the same sitting.

### 5.3 Radiographic findings

Plain X-rays do not show much in the early stages, except some soft tissue haziness or joint swelling in experienced hands. It is however, important to rule out fractures, tumours, and foreign bodies. It also acts as a baseline to which further x-rays are compared. Once there are bony changes on X-ray, the pathology has progressed to the chronic phase. X-rays are generally available in most parts of Africa and are fairly affordable.

Radionuclide scans may show an increased uptake in the acute phase. The test is neither sensitive nor specific for bony infection, and can be hot, cold, or normal depending on the stage of the disease. A recent retrospective comparative study showed that radionuclide bone scanning was sensitive in only 53% of cases of hematogenous osteomyelitis, whereas MRI was 98% sensitive. Both tests are expensive and not readily available for clinical use in Africa.

Ultrasonography is used to demonstrate effusion in joints, sub-periosteal collection and also for image guided aspiration. The presence of effusion does not necessarily mean infection and pus collection. Ultrasonography is widely available and affordable, but the expertise for orthopaedic pathology is not. It is not possible at this time to distinguish pus from pure effusion with certainty(19). A negative ultrasound does not rule out septic arthritis of the hip, as the ultrasound may have been done poorly, too early in the course of the disease (<24h), or the disease may be bilateral(20).

CT scan has no place in the acute phase, except to show collection in the muscle compartments. It has a place in the chronic phase as part of surgical planning.

### 5.4 Differential Diagnosis

Conditions considered in the differential diagnosis include transient synovitis of the hip, reactive arthritis including rheumatic fever, trauma, chronic infections (TB, fungal), sickle cell crises, haemophilic arthropathy, juvenile chronic arthritis, and HIV related arthritis.

### 5.5 Septic arthritis or transient synovitis

A common diagnostic dilemma is distinguishing septic arthritis of the hip, which requires prompt surgical drainage, from transient synovitis, which is a common, benign and self limiting condition. Because there is an overlap in the presenting symptoms and clinical and laboratory findings, no single finding or test result reliably distinguishes one condition from the other.

Recent studies have focused on combining clinical and laboratory findings to come up with clinical prediction rules determining the likelihood of septic arthritis. Based on a retrospective series of cases, Kocher et al found four criteria which, taken together, improved diagnostic performance. The criteria were fever >38.5C, refusal to bear weight, ESR>40mm/hr, and WBC>12,000/mm<sup>3</sup>. The likelihood of septic arthritis was 0.2% if no criteria were present, 3% if one, 40% if two, 93% if three, and 99% if four (21). Counting criteria became rapidly popular among residents, sometimes to the exclusion of applying common sense. When these criteria were tested in another population in the US, they did not apply equally(22). Furthermore,

when tested in a prospective series in the same hospital, the diagnostic utility dropped(23). Caird et al have shown from their studies that a combined elevation of CRP and ESR is more useful diagnostically than ESR alone (24), and Luhmann added the finding that a previous visit to another health care institution was an independent predictor of septic arthritis.

At present, it is useful to consider the clinical findings and laboratory tests together, and consider the Kocher criteria as a guide but not as an infallible tool. In the case of uncertainty, one must consider the serious negative consequences for the child of a missed or delayed operation for septic arthritis, and proceed with aspiration and/or arthrotomy as the ultimate diagnostic and also therapeutic step.

## 6. Treatment

### 6.1 Medical

The patient is admitted and rehydrated, as they are often dehydrated. Intravenous analgesia is started, and the affected limb splinted. Intravenous antibiotics, usually a combination to cover the most likely organisms are started. If septic arthritis is the diagnosis and acute drainage of the joint is planned, antibiotics may be withheld until pus is aspirated or drained in order to increase the diagnostic yield. Choice of antibiotics will usually include Cloxacillin for the staphylococcus and gentamycin or ampicillin for gram negatives. For the sickle-cell patient, ciprofloxacin is used to cover salmonella. The manufacturer's warning of a theoretical injury to the cartilage of skeletally immature has not been our experience. In the past we used chloramphenicol, but there is empirical evidence in Ghana that we have resistant strains of salmonella. In regions without resistant strains, chloramphenicol has been used for six weeks duration without causing anemia (25). For streptococcus, crystalline penicillin is the antibiotic of choice (26)(27)(28)(29)(12).

The temperature, vitals and lab investigations are monitored. The patient's clinical condition is also monitored. If there is no improvement within 36 hours, it means, there is pus collection, and this should be looked for and drained. When there is improvement, which is usually evident in 48 hours, the Intravenous antibiotics are continued for a further 3 days for consolidation and a switch is made to oral antibiotics for a further 3-6 weeks as an out-patient(30)(31)(32)(33). There are studies suggesting shorter duration of well absorbed antibiotics(30)(31).

A randomized control trial has shown that giving low dose dexamethazone for the first 4 days of treatment of septic arthritis, leads to a better functional outcome(34). A criticism of this single small study is that the functional outcome did not use a validated or well defined scale, and the addition of steroids to antibiotic management is not routine practice at present.

### 6.2 Role and indication for surgery

By the time most patients are seen in Africa, surgery is indicated. From the pathology, we realize that, from the onset of inflammation, without intervention, pus is formed within 72 hours. We see these patients in Africa usually late, and by which time, pus has already been formed(5)(6)(4)(2)(7)(8).

In the ideal situation, when there is no resolution of symptoms, in 36 hours, drainage is indicated. Even then, antibiotics will treat the systemic component, and therefore, the fever etc will settle, but does not necessarily mean the local component is under control. This is the reason frequent examination is imperative.

For septic arthritis, arthrotomy with washout is the safe standard procedure. We suggest that prompt surgical drainage via arthrotomy be the standard of care for septic arthritis of the hip joint in Africa. Open arthrotomy within five days of symptoms led to full uncomplicated recovery in all cases in a series of septic hips from South Africa (2), unfortunately the delay intrinsic at various stages in the health care system meant 66% of patients suffered complications or sequelae. It is common to see children's hip joints completely destroyed by infection in Africa, and the options for reconstruction and rehabilitation are few, costly, and complex. There are studies that have shown satisfactory results managing septic arthritis of the hip routinely with repeated aspirations, and open arthrotomy in 10 to 15% of cases where aspiration fails (35) (30). There may be the need for repeated aspirations (an average of four) in the operating room, a luxury most centres in Africa cannot afford. These studies came from Finland and Israel, places where the children may have better nutrition, better resistance, earlier presentation, and easier access to care so it is not currently clear that a protocol of hip aspiration for septic arthritis can be recommended in Africa. For the shoulder joint, there is a randomized trial performed in Malawi which showed that the results of aspiration seemed equivalent to the results of arthrotomy(36). Salmonella was responsible for 86%/73% of cases in the aspiration/arthrotomy groups, and it is possible that the results do not generalize to staphylococcal infections. 70% of patients with radiographs at six months showed glenohumeral damage, however range of motion, tenderness, and swelling were not clinically problematic for any child seen in followup at one year. Of 61 patients entered in the trial, only 24 were available for review, again limiting the certainty of the findings.

For osteomyelitis, drainage of pus under the periosteum is done by incising near the point of maximum tenderness or swelling. Drainage of pus within the medullary cavity by drilling through the cortex is recommended. Drill holes risk pathological fracture, and more intervention has been associated with more complications in series in Western countries, where the current trend is towards managing acute hematogenous osteomyelitis without surgery in the majority of cases. Again, this may reflect appropriate management in the healthy host with early presenting disease. In the African setting, acute hematogenous osteomyelitis that has not improved within 36 hours of antibiotic management should be considered for thorough drainage through incision and drilling. There is no role for further bony debridement, and the periosteum and soft tissues should be preserved because they play an important role in healing.

Surgical drains are not always necessary, some centres use them routinely for a few days. There is little evidence to guide this decision one way or the other.

### 6.3 Aftercare

Intravenous antibiotics are continued until clinical response is seen (cessation of fever, and resumption of use of the limb). The child is examined daily for local and systemic signs of infection. Failure to respond by four or five days is usually an indication for repeat drainage, and may prompt a careful clinical and/or imaging search for a second site of infection.

The limb is not immobilized postoperatively, rather use is encouraged in order to prevent stiffness and in order to gauge clinical response. The

exception to this principle is in the case of an infant with a septic dislocation of the hip, in which case a spica cast in mid-abduction is used to maintain reduction of the joint during healing.

## 7. Conclusion

Early diagnosis and prompt intervention are crucial for a successful outcome in these common childhood conditions. An estimate of the numbers of cases in Africa suggests that the size of the problem likely outstrips the size of the current surgical workforce. The organisms responsible vary by age and by region, so understanding of local disease patterns will be helpful in management. Prompt surgical drainage of septic hip joints is recommended, and the use of scoring systems such as that of Kocher can help to distinguish these from transient synovitis. Aspiration instead of arthrotomy can be considered for joints other than the hip, but has not been clinically proven in staphylococcal infections in deprived children. Operative drainage of osteomyelitis can be reserved for children who have not responded clinically to 36 hours of antibiotic treatment. Three to six weeks of oral antibiotics are sufficient following good response to initial intravenous doses.

Outcome studies indicate that many children go on to debilitating sequelae such as destroyed hip joints or chronic osteomyelitis. Such tragic outcomes from a common, treatable disease suggest renewed efforts in the clinical management and in access to care.

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