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Septic Arthritis Management : Current Guidelines

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Abstract

Septic arthritis is an orthopaedic emergency that is more commonly seen in infants and young children. Release of proteolytic enzymes leads to permanent destruction of intra-articular cartilage and subchondral bone as early as 72 hours after onset. Hip and knee are the most commonly involved joints. Staphylococcus aureus is the most common causative organism across all paediatric age groups. Recently, there is a significant increase in the incidence of Klebsiella and Pseudomonas, especially in neonates. Sensitivity patterns of causative organisms are also changing with increasing resistance to empirical antibiotics, requiring the use of higher antibiotics.

The detection of septic arthritis in neonates is challenging. The physician has to rely on indirect signs and maintain a high index of suspicion. Raised CRP along with difficulty in weight bearing have a better predictive value in diagnosis. Ultrasonography (USG) is a useful tool for quick screening of a joint and to detect effusion. Many recent studies have suggested percutaneous drainage/aspiration as an equally effective modality to manage septic joints, thus avoiding the morbidity of open arthrotomy and the risks of general anaesthesia. Lack of response to minimally invasive methods warrant an open approach. Antero-lateral arthrotomy is preferred over the posterior approach to avoid iatrogenic damage to the blood supply of the femoral head. Arthroscopic lavage of the septic joint is also becoming popular. The choice of empiric antibiotic treatment should be based on age, vaccination status and underlying co-morbidities. There is growing evidence in literature for short-course intravenous (IV) therapy. Delayed diagnosis, sickle cell disease, and infection caused by certain strains of methicillin-resistant staphylococcus aureus (MRSA) are predispose patients to orthopedic sequelae.

Keywords: Septic Arthritis, Arthrotomy, Osteomyelitis

Introduction

Septic arthritis is defined as inflammation of a synovial joint secondary to infection which is mostly bacterial but can be fungal, mycobacterial, viral or from other rare pathogens [1]. It is more common in infants and children than adults. It is an orthopaedic emergency which can lead to permanent joint damage and disability if not managed in timely fashion. It can be associated with osteomyelitis or pyomyositis.

The most common route of infection is hematogenous seeding from a distant site. Other causes include contiguous spread from surrounding muscle or bone. Direct inoculation can also occur from inadvertent joint penetration during a deep intramuscular injection, intravenous/intra-articular sampling, or penetrating trauma [2,3].

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Table 1: Common pathogens responsible for Septic arthritis in various age groups

Age	Organism
Infant 0 – 2 months	Staphylococcus aureus Streptococcus agalactiae Gram negative enteric bacteria Coagulase negative staphylococci Neisseria gonorrhoeae Candida
2 months – 5 years	Streptococcus pneumoniae Staphylococcus aureus Streptococcus pyogenes Streptococcus pneumoniae Kingella kingae Haemophilus influenzae type b (in non-immunized child)
>5yrs	Staphylococcus aureus Streptococcus pyogenes
Adolescent	Neisseria gonorrhoeae
Associated with immunosuppression	C. immitis B. dermatitis H. capsulatum C. neoformans Gram negative bacteria
Possible causes in endemic areas Tick exposure Travel/contact Rat exposure	Borrelia burgdorferi (Lyme disease) Mycobacterium tuberculosis Streptobacillus moniliformis
Rare causes (All age groups)	Viral (Rubella, parvovirus B19, varicella zoster, hepatitis), Candida, anaerobes, Brucella

Table 2: Differential Diagnosis of Septic Arthritis

Differential Diagnosis
Acute Synovitis
Acute Osteomyelitis
Viral Arthritis
Reactive Arthritis
Juvenile Rheumatoid Arthritis
Legg-Calve-Perthes Disease

Epidemiology

Annual incidence of septic arthritis in children varies between 5 and 12 cases/100,000 persons. It varies significantly in different geographical regions. In developed countries like Israel, the incidence is as low as 1 in 100,000 persons whereas in the developing world, it can be as high as 5-20 cases/100,000 persons. In India, its reported incidence is 1 per 1500 persons [4]. Another study has reported its incidence in India as 0.6 per 1000 live births in comparison to the global incidence of 0.3 per 1000 live births [5]. Majority of studies from India and western countries suggest male predominance [4].

Commonly associated risk factors for septic arthritis include prematurity, low birth weight, respiratory distress, neonatal intensive care unit (NICU) admission, umbilical artery catheterization, immunodeficiency etc.

Monoarticular large joint involvement is more common than polyarticular small joint involvement. Hip and knee are most commonly affected. Shoulder joint predominance is seen in Africa. Other involved joints include elbow, wrist, ankle, sacroiliac and metatarsophalangeal joints.

Patho-physiology

The pathogenesis of septic arthritis is multifactorial and the outcome depends on interaction of host immune response and invading pathogen. In the majority of cases, septic arthritis in children develops secondary to hematogenous seeding of the synovial membrane. Lack of limiting basement membrane in the synovium makes synovial joints more prone for hematogenous spread. In the joints where metaphysis is intracapsular (hip, shoulder, ankle and elbow), the primary focus can be metaphyseal, with secondary spread into the joint. Trans-physeal blood vessels in children less than 18 months can disperse the infection from the metaphysis to the joint and vice-versa.

The virulence and tropism of microorganisms, combined with the resistance or susceptibility of the synovium to microbial invasion, are major determinants of joint infection.

In the majority of cases, the host mounts a strong protective inflammatory response leading to control of pathogens and resolution of infection. However, in cases with a higher bacterial load and/or already compromised host, the clearance of infection may take longer leading to prolonged and potent activation of the immune system with higher levels of cytokines (IL 1beta, IL 6, TNF alpha) and reactive oxygen species resulting in joint destruction. Polymorphonuclear response with release of proteolytic enzymes leads to permanent destruction of intra-articular cartilage and subchondral bone as early as 3 days [7].

Causative Organisms

Staphylococcus aureus is the most common causative organism across all paediatric age groups (Table 1). Other common organisms include Streptococcus pyogenes, S. agalactiae, S. pneumoniae, Kingella kingae, gram negative enteric bacteria, fungi like candida and aspergillosis, and some other rare pathogens [6]. There is a significant increase in cases affected by klebsiella and pseudomonas especially in neonates. Also, there are increasing reports of Methicillin resistant Staphylococcus aureus (MRSA) cases both from the developed and developing countries. MRSA affected cases are more seriously ill with longer hospital stays as compared to MSSA (Methicillin sensitive Staphylococcus Aureus). Community associated MRSA strains exhibit lower antibiotic resistance than Hospital acquired MRSA strains. Salmonella associated septic arthritis is seen in children with sickle cell disease.

There are reports of changing sensitivity patterns with increasing resistance to empirical antibiotics and sensitivity to higher antibiotics.

Principles and Differential Diagnosis

Presentation and Differential Diagnosis depends on the age group of the child. The description below is the classical

presentation of septic arthritis. This is altered by the presence of immunosuppression or recent use of antibiotics. Several similar differential diagnoses [8] (Table 2) have to be excluded before a definitive diagnosis is made.

Presentation in Neonates

The detection of septic arthritis in neonates is more challenging. The physician has to rely on indirect signs and maintain a high index of suspicion.

Tell-tale signs in neonates:

- Swollen, warm joint with surrounding erythema.
- Fever: Inconsistent finding. Occurs in MRSA-induced septic arthritis but pathogens such as Kingella kingae are associated with mild or no fever [9, 10].
- Multiple joint involvement is possible.
- Paucity of active joint movements, which can be easily appreciated when child is suspended.
-Attempted passive movement is painful.
- The joint is kept in a flexed attitude. This is done to accommodate the swelling and reduce pain.
- The hip joint is kept flexed, abducted and externally rotated initially. This progresses to adduction and internal rotation as the hip joint subluxates.

Presentation in older Children

Septic arthritis can present in a variety of ways.

- The classic presentation is an acutely swollen, red, painful joint.
- Fever is an inconsistent sign [10].
- There is considerable pain with attempted motion.
- The resultant paucity of movement of the limb is often called pseudo-paralysis.
- If the lower limb is involved, the child is unable to bear weight on the limb.
- Refusal to bear weight on the limb is a very sensitive sign.

Haematological Criteria

In cases with suspicion of septic arthritis, blood investigations are important for diagnosis. Erythrocyte sedimentation rate (ESR), total white cell and differential counts in peripheral blood samples, CRP and blood culture are the mainstay of haematological investigations.

Traditional method of predicting Septic Arthritis over Transient Synovitis is based on Kocher's criteria [11], which is based on four clinical variables:

- History of fever
- Non weight bearing
- ESR of >or=40 mm/hr and
- A serum white blood cell count of >12000/mm^3 (>12 x 109/L).

However, recent studies emphasise CRP over ESR as a predictive factor. CRP, in addition to restriction of weight bearing, has been found to have a better predictive value in diagnosis [6]. Difficulty in weight bearing, ESR > 20mm/hr and CRP > 20.0 mg/l with acute inflammation of joint are indicative of septic arthritis and need further confirmation through synovial fluid aspirate, cytology and culture [12,13]. Among the haematological parameters, CRP > 20 mg/l is the strongest independent risk factor for septic arthritis. [13]

Investigations

X-Ray

X-Rays are not very useful in an acute setting. Medial joint space widening or subluxation of hips are characteristic signs. When the x-rays are performed later than a week from onset, erosion of the proximal femur or subluxation of the hip joint may be seen.

Ultrasound

In the acute setting, it is a useful tool for quick screening of a joint. Ultrasound enables the detection of effusion and the nature of effusion. Echogenic debris inside the joint points to purulent collection rather than effusion. It is also useful for aspirating deep joints. Quantity of fluid within joint does not differentiate septic arthritis from transient synovitis.

MRI

Has limited use in acute septic arthritis but useful for the detection of associated osteomyelitis or deep abscess in older children. In infants, routine use of MRI is limited by the need for general anaesthesia.

Synovial Fluid

Arthrocentesis is indicated in the presence of an effusion on ultrasonography associated with an ESR > 20 mm/hr and CRP > 20 mg/l. The aspirate can be sent for bacteriology along with total and differential white cell count (WCC) [12]

Synovial Fluid Analysis

A frankly purulent aspirate is diagnostic of septic arthritis. Frequently, the synovial fluid findings are non-specific. When the joint aspirate has a WCC of >50,000/µL and polymorphonuclear cells constitute greater than 75%, it is suggestive of septic arthritis.

Culture & Sensitivity

Synovial fluid cultures may be negative in up to 70% of cases [14]. The yield can be improved by aerobic blood and agar plate cultures, in particular for the diagnosis of Kingella kingae infections.

Timing of Surgical Intervention

Once the diagnosis of septic arthritis is confirmed, it is considered a surgical emergency. Cartilage erosion starts as early as 8 hours from the time of initial bacterial invasion of the joint space. Permanent cartilage damage is more likely when the treatment has been delayed for longer than five days. Delayed treatment results in damage to the physis, articular cartilage, femoral head necrosis and metaphyseal osteomyelitis. While appropriate antimicrobial therapy is paramount, it is not an alternative to surgical clearance of the joint [15].

Aspiration

Recent studies have reported that early diagnosis and treatment of septic arthritis is more important than the mode of drainage [16, 17]. In a series of 49 joints drained, 34 improved with percutaneous aspiration and antibiotics, while others required surgical drainage after lack of response to non-operative treatment. The authors reported that satisfactory outcomes can be still expected after operative management [16]. Givon et al reported a series of 28 children undergoing repeated ultrasound-guided aspiration under local anaesthesia. 3 to 5 aspirations (3.6 average) were required per patient for resolution. Four patients out of twenty-eight required further hip arthrotomy. They report that this approach obviates the need for anaesthesia and open drainage thereby expediting functional recovery [17]. Weigl et al reported that repeated aspiration is a safe and satisfactory method of treatment. They found that children > 10 years had a higher rate (57%) of requirement of arthrotomy. The authors report that by utilising this approach, they could avoid arthrotomy in 79% of patients with septic arthritis [18]. In a recent study, continuous double-lumen catheter drainage has been advocated as a part of minimally invasive approach to drain septic hips and found promising outcomes [19].

Arthrotomy

Open arthrotomy is the conventional approach for drainage of septic arthritis. Lack of response after minimally invasive methods warrants an open approach. In the hip, an anterolateral arthrotomy is preferred over the posterior approach to avoid iatrogenic damage to femoral head vasculature. Placement of a drainage tube is recommended for suspected adjacent infections. A study revealed that repeat arthrotomy was required in patients with a left shift in WBC, pyrexia postoperatively and positive blood and tissue cultures [20]. Failure to recognise associated pyomyositis in adjacent pelvic muscles may lead to adverse outcomes. Gupta et al found protrusio acetabuli as a sequel of septic arthritis and associated untreated obturator internus abscess. They recommended a dual approach in treating these patients [21].

Arthroscopy

Despite an initial learning curve, arthroscopic lavage of the septic joint is becoming popular. Garg et al reported the outcome of 14 hips treated by single anterolateral portal arthroscopic lavage [22]. While all the hips resolved symptomatically, two required arthrotomy due to inadequate response. Three patients were younger than 1 year of age. One patient developed transient femoral nerve palsy. Gourineni et al reported similar results with single portal hip arthroscopy for drainage, joint lavage and placement of a drainage tube [23]. Edmonds et al studied the safety of a medial portal for arthroscopic drainage in infants. They observed a wide safety margin and a minimum 5.5 mm interval of adductor longus between the medial portal needle and the femoral neurovascular bundle [24].

Concurrent Osteomyelitis

In a recent series of 87 children with septic arthritis of the hip, a concomitant adjacent infection was found, based on MRI, in 51% of patients [25]. A failure to detect concurrent osteomyelitis can lead to adverse outcomes and repeat surgical intervention. Several authors have attempted to identify factors predictive of adjacent infection in septic arthritis. Rosenfeld et al studied five variables including age > 3.6 years, CRP >13.8 mg /L, duration of symptoms > 3 days, platelets <314 x 103 cells /μ L and absolute neutrophil count > 8.6x103 cells /μL. They found that patients who met ≥3 of these criteria were at high risk of adjacent infection and it was recommended to perform pre-operative MRI in such cases. Another study found concurrent infection in 21% of patients. Newborns and adolescents, shoulder septic arthritis and symptom duration greater than 6 days prior to presentation were found to be significantly associated factors [26]. Schlung et al recommended aspiration of the femur during open incision and drainage to aid in the diagnosis of concurrent osteomyelitis, especially in false negative MRIs. They performed proximal femoral drainage, when the neck aspiration revealed evidence of infection (purulent aspirate or aspirate white cell count > 50,000) [27].

In children who are not critically ill and for whom an aspirate or biopsy is being planned prior to initiating antibiotics, it is advisable to withhold antibiotics for 48 to 72 hours, under inpatient observation. However, children with septicaemia or rapidly progressive infection, empiric antimicrobial therapy should be commenced immediately [28]. The choice of empiric antibiotic treatment should be made on the suspicion of pathogens based on age, vaccination status and underlying comorbidities.

Choice of antibiotic

The commonest organism is Staphylococcus aureus, followed by group A Streptococcus and Enterobacter. Haemophilus influenza has been virtually eliminated through vaccination. Treatment options include vancomycin for gram-positive cocci, ceftriaxone for gram-negative cocci, and ceftazidime for gram-negative rods. However, If the gram stain is negative but there is suspicion of bacterial arthritis, vancomycin with either ceftazidime or an aminoglycoside is appropriate [29].

First-generation cephalosporins and clindamycin are sufficient, but these should be administered in large doses and 4 times a day as these are time-dependent antibiotics. Clindamycin is a valid option in regions where the prevalence of MRSA strains exceeds 10% and that of clindamycin-resistant strains remains <10%. If clindamycin resistance is common, vancomycin is the first option of treatment; despite concerns of poor bone penetration [30]. Penicillin monotherapy is suitable for Streptococcus pyogenes and S. pneumoniae, provided large doses are given. In children who are allergic to penicillin, vancomycin or clindamycin along with a quinolone is recommended. Children who have received a Haemophilus type b vaccination do not require adjuvant ampicillin or amoxicillin. K. kingae is susceptible to most beta-lactam antibiotics. Fluoroquinolones or third-generation cephalosporins are valid options for gonococcal septic arthritis, but cost may be an issue in low socio-economic groups [31].

Duration of treatment

There is growing evidence that short-course IV antibiotic treatment is adequate and that longer term therapy should be reserved for patients who fail to respond. Shortened IV therapy in accordance with the patient's response to treatment resulted in no recurrence or persistence of infection [32]. After a short 2-to-4-day intravenous course, the antibiotic is switched to oral, if the patient is recovering and CRP level is declining. A total course of 2 weeks is sufficient in uncomplicated cases. If an adjacent bone is involved, the antibiotic treatment should be extended to last for at least 3 weeks [33]. MRSA should be treated for at least 4 weeks. Discontinuation of antimicrobial therapy is based on clinical improvement (i.e., when fever improves and the majority of local symptoms and signs subside) and the CRP levels reduced to below 20 mg/L, regardless of the ESR. If the clinical signs have not subsided or the CRP level remains elevated or increases again, therapy should be continued until 2 consecutive CRP levels are normal.

Post Treatment Protocols

Delayed diagnosis, sickle cell disease, and infection caused by certain strains of MRSA predispose to orthopaedic sequelae. Osteoarticular infections have a tendency to recur and long-term sequelae may develop slowly. Frequent follow ups scheduled at 2 weeks, 3 months and 1 year after hospitalisation should be considered paying special attention to potential sequelae. Radiographs should be performed, and ESRs and CRP levels checked routinely. Relapses are rare if large-dose short course antibiotic treatment has been administered properly [34]. Long term follow-up of 1-2 years may be required to detect any possible complications.

Conclusion

Septic arthritis is an orthopaedic emergency and should be managed in timely fashion. Permanent cartilage destruction occurs as early as 3 days from onset. The incidence of gram-negative infections (klebsiella and pseudomonas) is increasing. Detection of septic arthritis in neonates is challenging and clinicians have to rely on indirect signs. USG is a good tool for quick screening of a joint. Percutaneous drainage and arthroscopic lavage are gaining popularity as equally effective options in managing septic arthritis. Short course IV antibiotic therapy is becoming popular and replacing long-course therapy, except in complicated cases.

Declaration of patient consent : The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/her images and other clinical information to be reported in the journal. The patient understands that his/her names and initials will not be published and due efforts will be made to conceal his/her identity, but anonymity cannot be guaranteed.

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