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Review Article

Septic Arthritis of the Hip – Diagnosis and Management

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Abstract

Early diagnosis together with appropriate treatment is essential for the management of septic arthritis of the hip. Abnormal joint anatomy and intra-articular injections increase the risk of joint infection in adults. In children-young age, male gender, respiratory distress syndrome, umbilical artery catheterization, phagocytic deficiencies, haemoglobinopathies, joint interventions and instrumentation of the urinary or intestinal systems are risk factors. *Staphylococcus aureus* is the most commonly identified pathogen while a growing concern is the methicillin-resistant *Staphylococcus aureus*. Most adults present with one or two week history restricted motion and painful joint. At least two sets of blood cultures should be obtained before initiating antibiotic treatment. Blood samples for white blood cell count, erythrocyte sedimentation rate and C-reactive protein concentration should also be obtained. Synovial fluid white cell count of > 50,000 cells/mm^3 is considered diagnostic for septic arthritis. Specimens for gram-stain and culture should be obtained before antibiotic therapy is started. Repeat aspiration is an available option in the paediatric age group, but open arthrotomy remains the gold-standard for surgical treatment. As opposed to arthrotomy, hip arthroscopy offers a minimally invasive approach, increased access to the hip joint and improved visualization, while eliminating risks such as avascular necrosis of the femoral head, joint instability, need for large surgical exposure, scarring, postoperative pain and prolonged hospital stay. The initial antibiotic choice is based on the patient's clinical history and risk factors, local prevalence of drug-resistant pathogens and Gram-stain results. As *Staphylococcus aureus* is the most common pathogen empiric antibiotic treatment with β-lactamase-stable penicillins is recommended. UK guidelines recommend intravenous antimicrobial therapy for two weeks followed by four weeks oral therapy.

INTRODUCTION

Septic arthritis of the hip is a bacterial infection of the synovium that can lead to destruction of the joint and systemic infection. Early diagnosis and appropriate treatment are critical to reduce morbidity such as joint destruction and mortality which is estimated to be around 11% [1]. In the literature there is limited data about the incidence of septic arthritis of the hip in the adults. The estimated incidence of adult septic arthritis in Western Europe is 4-10 per 100,000 patient-years per year [2,3]. The incidence appears to increase in lower socio-economic groups such as aboriginal Australians where the prevalence is 29 cases per 100,000, with a relative risk of 6.6 compared with the white Northern Territory Australian population [4]. Incidence of septic arthritis in the United States appears to be increasing [5].

The estimated incidence of septic arthritis of the hip in the paediatric age group is 1:20,000 [6], while boys are more often affected than girls [6-8]. Complications of paediatric hip septic arthritis include: growth plate damage [9] with leg length discrepancy [10], osteoarthritis [11], hip dislocation [9,10], limited range of motion [10], avascular necrosis (AVN) of the femoral head [11], sepsis [11] and lysis of the femoral head and neck [12].

Risk factors

Abnormal joint anatomy as seen in rheumatoid arthritis, crystal induced and Charcot's arthropathy is considered risk factor for septic arthritis in adults [13,14]. It is estimated that 41.8% of adult joint infections are iatrogenic and it is probably related to an increase in intra articular orthopaedic procedures being performed [2]. It is also suggested that intra articular steroids [15] and hyaluronate [16] injections increase the risk of joint infection. In children most cases occur by haematogenous dissemination of bacteria [7,9,17]. Risk factors include young age, male gender, respiratory distress syndrome, umbilical artery catheterization, phagocytic deficiencies, haemoglobinopathies, joint interventions and instrumentation of the urinary or intestinal systems [18,19].

Causative organism

Staphylococcus aureus is the pathogen most commonly identified in adults with septic joints. Methicillin-resistant *Staphylococcus aureus* (MRSA) is becoming a problem among intravenous drug users, the elderly, exposure to health-care and orthopaedic related infections [1,20,21]. Gram-negative organisms are isolated from 5-20% of patients with bacterial septic arthritis [13,22]. There is also an increase in prevalence of infections with multi-drug resistant enterobacteriaceae [23]. Once common, gonococcal infections in sexually active adults are now a less common cause of septic arthritis [1,13,21] (Table 1).

The most common causative organism of septic arthritis of the hip in children is *Staphylococcus aureus* [6-8,17,19, 24-28]. There is increased incidence of infections caused by community-associated MRSA [28-30]. Septic arthritis caused by MRSA is associated with longer duration of fever after the initiation of treatment and longer hospital stay when compared with septic arthritis caused by methicillin-sensitive *Staphylococcus aureus* (MSSA) [29,31,32]. Other causative organisms are group A *Streptococci*, group B *Streptococci*, *Streptococcus pneumoniae*, Coagulase-negative *Staphylococci* and *Enterococcus* species. Vaccination against *Haemophilus influenza* decreased the incidence of septic arthritis caused by this organism [7] (Table 1).

Diagnosis

Most adults with septic arthritis of the hip present with one or two week history of restricted motion and painful joint [1]. Symptoms such as history of fever, sweats and rigors are present in less than 50% of patients [1]. As most cases of septic arthritis occur by haematogenous spread at least two sets of blood cultures should always be obtained before initiating antibiotic therapy in order to increase the chance detecting the causative organism [33]. Blood samples for white blood cell (WBC) count, erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) concentration should be obtained. Normal values of these tests have been reported in the setting of septic arthritis [1,34], but when raised they are useful monitoring treatment. Some studies indicate that Procalcitonin (PCT) may be a useful predictor of septic arthritis [35,36]. Biomarkers such as tumour necrosis factor α (TNF-α), interleukin (IL)-6, IL-10, and lipopolysaccharide binding protein (LBP) may be helpful for the diagnosis of prosthetic joint [36]. Kidney and liver function should be assessed as they affect antibiotic choice and dose [33].

Table 1: Common bacteria identified in bacterial septic arthritis.

Adults		Children	
Organism	**%**	**Organism**	**%**
Staphylococcus aureus	44	*Staphylococcus aureus*	44
Streptococcus pyogenes	8	*β-haemolytic streptococci*	15
Streptococcus pneumoniae	7	*Kingellakingae*	14
Haemophilusinfluenzae	4	*Streptococcus pneumoniae*	10
Mycobacterium tuberculosis	4		
Escherichia coli	4		
Coagulase-negative staphylococci	4		

Synovial fluid aspiration serves as the best diagnostic tool. The combination of synovial fluid white cell count and high percentage of polymorphonuclear cells is the best predictor for septic arthritis before synovial fluid culture results are known [37]. Synovial fluid WBC count of > 50,000 cells/mm^3 is considered diagnostic for septic arthritis, although lower counts have been also observed [1,33,37]. Specimens for Gram-stain and culture should be obtained before antibiotic therapy is started. These will provide definitive diagnosis and guide the choice of antibiotic treatment. In cases were culture results are negative [3] or antibiotic therapy is administrated before synovial fluid is obtained, universal microbe nucleic acid amplification and sequencing by polymerase chain reaction (PCR) are useful tools [38], and may have a role as an adjunct to cultures for organisms which are difficult to grow or polymicrobial infections [39,40].

Of all non-traumatic painful paediatric hip presentations, transient synovitis is the most common [9,11]. Occasionally, there are difficulties differentiating between septic arthritis and transient synovitis [27]. Accurate diagnosis is important in these cases as the long term sequelae are different and the two require different management [26,27]. Kocher et al. [41], performed a retrospective study using four clinical predictors to differentiate between septic arthritis and transient synovitis: fever ≥ 38.5°C, inability to bear weight, ESR ≥ 40 mm/hour, WBC > 12,000 cells/mm^3. These authors found that the predicted probability for septic arthritis in case all four predictors are positive is 99.6%. The same authors validated their findings in a prospective study [42] and found that the predicted probability was only 93% when all four predictors were positive. Luhmann et al. [43], used the same predictors in a retrospective study and found a predicting probability of 59%. Caird et al. [44], added CRP > 20mg/L as a fifth predictor in a prospective study and found a predictive probability of 98% when all five predictors were present, while Sultan et al. [27], using the same five predictors in a retrospective study found a predictive value of 59.9%. Singhal et al. [26], demonstrated that CRP is the most significant independent predictor of paediatric hip septic arthritis with 74% predicted probability when two variables were present (elevated CRP and inability to bear weight), and 87% predicted probability with four variables (fever ≥ 38.5°C, inability to bear weight, CRP ≥ 20mg/L, WBC > 12,000 cells/mm^3).

Although its sensitivity in acute infection is low, conventional radiograph of the affected site is recommended in all cases in order to exclude other processes [45]. Ultrasound is helpful for detection of fluid in suspected hip infections, obtaining fluid for laboratory investigations and allows for early drainage of the joint [46]. Although a negative result on ultrasound imaging of the hip is sensitive and the absence of fluid in the hip generally rules out a septic arthritis, similar symptoms can be caused by a nearby osteomyelitis or pyogenic myositis and need to be followed by an MRI [45].

Surgical Management

Most authors agree that early operative intervention remains the mainstay of treatment in all cases of septic hip arthritis

regardless of patient age or causative organism [47]. Repeat aspiration is an available option in the paediatric age group [24,48]. In children, open arthrotomy may result with damage to the proximal femoral growth plate blood supply [49,50], while in adults it may require an extensive surgical approach and even surgical dislocation [51]. Hip arthroscopy is becoming more popular in the management of hip septic arthritis; it offers a minimally invasive approach, increased access to the hip joint and improved visualization, while eliminating risks such as AVN of the femoral head, instability, extensive surgical approach, scarring, postoperative pain and prolonged hospital stay [50-60].

Both the supine position as described by Byrd [61] and the lateral decubitus as described by Glick et al [62] are used. Irrigation is performed with either normal saline or lactated Ringer solutions. The fluid volume used for irrigation varies between 500 ml and 25 litres. The number and location of the arthroscopic portals differ between studies. Except one study [58], all other studies used some form of postoperative drainage. We prefer the supine position, using a 3-portal arthroscopic technique including synovectomy and use 6-8 litre of physiologic saline solution for irrigation. We do not use postoperative drains eliminating the risk of drain entrapment [50,58].

In a systemic review, all 65 patients who underwent arthroscopic drainage and were reported in the literature significantly improved after surgery [63]. Most of them were asymptomatic and without limitation in their affected hip range of motion [63]. Patients demonstrated excellent Bennet radiographic assessment and Harris Hip Scores [50,55]. In one study, occasional hip pain was observed in 10% of patients [59]. Blitzer reported that two patients out of five demonstrated progression to arthritis and one patient required a repeat arthroscopic drainage 17 months after the initial surgery for recurrence [52]. A systemic review of the literature around hip arthroscopy for the management of septic arthritis found no arthroscopy related complications in these cases, and the authors concluded that arthroscopic drainage is safe and effective for the management of septic arthritis of the hip [63]. When compared with open arthrotomy, patients treated with arthroscopy had a shorter hospital stay [51]. Arthroscopic management of septic arthritis of the hip leads to rapid recovery together with symptomatic improvement with no reported complications [63].

In cases of septic arthritis in childhood where good clinical response and improvement in CRP levels are observed within 24 hours after initiation of antibiotic therapy, Peltola et al. [64], recommended no repeat aspiration or arthrotomy apart from the initial diagnostic needle aspiration. Pääkkönen et al. [25], performed a multicentre study of 62 patients with childhood septic arthritis of the hip treated with large doses of antibiotics for at least 10 days, and found that 50 (81%) of them did not require surgical intervention. The authors demonstrated that if patients presented within 5 days from the start of symptoms, diagnostic aspiration and antibiotic treatment were sufficient [25].

Antibiotic Treatment

No randomised controlled trials were performed to evaluate advantage of one therapeutic regimen over the other. A meta-analysis did not demonstrate superiority of one antimicrobial agent over another for the management of bone and joint infections [65]**.** The initial antibiotic choice is based on the patient's clinical history and risk factors, local prevalence of drug-resistant pathogens and Gram-stain results (66). When septic arthritis is suspected, even in cases where Gram-stain is negative, empiric antibiotic treatment should be started [66] and later adjusted based on definitive culture results. Furthermore, in cases where septic arthritis is highly suspicious but cultures are negative, a full treatment course with empiric antibiotics should be continued based on clinical response [66].

Because *Staphylococcus aureus* is the most common pathogen in all risk groups, empiric antibiotic treatment with β-lactamase-stable penicillins such as flucloxacillin or cephalosporins is recommended before organism identification [33]. Modification of empiric antibiotic treatment to include activity against MRSA should take place in high risk cases, such as nursing-home residents, recent hospitalization, or where the incidence of community associated MRSA is higher than 10% [67]. In these cases, glycopeptide such as vancomycin, are recommended. In cases of patients at risk for sexually transmitted diseases, ceftriaxone plus azithromycin or doxycycline can be used empirically [66]. Intravenous drug users should be treated empirically with vancomycin and antipseudomonal β-lactam active against MRSA and gram-negative bacilli [22,68].

There is limited data defining the best duration of antibiotic treatment for septic arthritis, with the exception of treatment for Gonococcal infection, where patients are usually treated with a third-generation cephalosporin for one to two weeks [66,69]. Treatment is given generally for up to six weeks, with two to four weeks of intravenous antimicrobials [66,69] followed with oral antibiotics when available and when clinical signs, symptoms and inflammatory markers are improving [33]. UK guidelines recommend intravenous antimicrobial therapy for two weeks followed by four weeks oral therapy [3]. Intravenous antibiotics can be provided on an outpatient basis allowing an early hospital discharge [58,69].

Vaccination against *Haemophilus influenzae*, increased the incidence of *Staphylococcus aureus* septic arthritis in childhood [7]. Several authors recommend empiric antibiotic treatment with clindamycin against MRSA in all cases of paediatric septic arthritis because of its increasing prevalence in septic arthritis [17,19,28-32]. More than 10% of MRSA isolates are resistant to clindamycin [31]. Alternatives include vancomycin [19,29,31,32], trimethoprim-sulphamethoxazole [19,29,31,32], and linezolid [19,31,32]. According to Peltola et al. [64], and Pääkkönen et al. [25], a short term antimicrobial therapy for 10 days is sufficient in children with septic arthritis. According to these authors, clindamycin or first-generation cephalosporins is administered during the first two to four days in previously healthy children older than three months, who present with septic arthritis of the hip caused by gram-positive bacteria. Since MRSA infections are more serious than those caused by MSSA [29,31,32] antibiotic treatment may take longer [70].

SUMMARY

Early diagnosis of septic arthritis of the hip joint together with early appropriate treatment is critical to reduce morbidity

and mortality. Abnormal joint anatomy is a risk factor for septic arthritis in adults. The rate of iatrogenic joint infections has increased as a result of an increase in intraarticular orthopaedic procedures performed and intraarticular injections. Risk factors in children are young age, male gender, respiratory distress syndrome, umbilical artery catheterization, phagocytic deficiencies, haemoglobinopathies, joint interventions and instrumentation of the urinary or intestinal systems. *Staphylococcus aureus* is the most commonly identified pathogen in all age groups while methicillin-resistant *Staphylococcus aureus* is an increasing problem. At least two sets of blood cultures should always be obtained before initiating antibiotic therapy. Blood samples for WBC, ESR and CRP concentration should be obtained. Synovial fluid aspiration serves as the best diagnostic tool. Specimens for gram-stain and culture should be obtained before antibiotic therapy is started. Repeat aspiration is viable treatment option in the paediatric age group. Open arthrotomy considered in the past as gold-standard surgical treatment, is losing its popularity to hip arthroscopy which offers a minimally invasive approach, increased access to the hip joint and improved visualization, while eliminating risks such as AVN of the femoral head, instability, extensive surgical approach, scarring, postoperative pain and prolonged hospital stay. There is no superiority of one antimicrobial agent over another for the management of joint infections. The initial antibiotic choice is based on the patient's clinical history and risk factors, local prevalence of drug-resistant pathogens and Gram-stain results. When septic arthritis is suspected, even in cases where Gram-stain is negative empiric antibiotic treatment should be initiated and later adjusted based on definitive culture results. Because *Staphylococcus aureus* is the most common pathogen empiric antibiotic treatment with β-lactamase-stable penicillins is recommended.

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