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Evaluation and Management of Septic Arthritis in Emergency Department "Narrative Review"

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Septic arthritis (SA) is a secondary infective disease due to joints inflammation. It often appears with mono- or oligoarticular acute arthritis that frequently leads to an emergency department (ED) visit with need for prolonged hospitalization. SA is an orthopedic emergency that can threaten both life and limb due to its potential rapid destruction of the joint with fulminant sepsis, causing significant disability within hours to days. Delayed or poor treatment of septic arthritis can lead to irreversible joint damage with consequent disability in addition there to significant mortality rate. Management includes early detection and treatment with antibiotics, joint aspiration, and consultation for orthopedic surgery as potential operative management. This review aims to summarize current evidence regarding evaluation and management of septic arthritis in emergency department, and to highlight the difficulties of diagnosing and managing SA that face the healthcare providers to help overcome those difficulties and to recommend further studies to be done regarding those problems and their solutions.

Keywords: Septic arthritis; emergency; management.

1. INTRODUCTION

Septic arthritis (SA), is an inflammatory process secondary to infection in the joints. It often appears with mono- or oligoarticular acute arthritis, or multiple systemic comorbid conditions in patients with overwhelming conditions that frequently leads to an emergency department (ED) visit with need for prolonged hospitalization. It is infective secondary disease to etiology, usually bacterial, but also sometimes fungal, viral, mycobacterial, or other infrequent pathogens [1]. Regarding pathogenesis, septic arthritis is multifactorial and relies on the interaction of the host immune response and the attacking pathogen [2]

The occurrence of septic arthritis ranges from 2 to 6 cases per 100,000 people but differs based on the presence of risk factors; however, it is more frequent in children than in adults and occurrence of septic arthritis peaks between ages 2 and 3 years and has a male major prevalence (2:1) [3]. Mortality rates can be substantial, ranging from 3–25% [3, 4]

Most septic joints progress as a result of hematogenous seeding of the vascular synovial membrane due to an episode of bacteremia. Even though being a rare cause, septic arthritis may also take place as a result of joint aspiration, or local corticosteroid joint injection. Besides, bacterial arthritis may rise secondary to penetrating trauma (such as human or animal bite, or nail puncture) or after trauma to a joint without a clear break in the skin. The direct introduction of bacteria during joint surgery has progressively been a source of bacterial arthritis, mainly in association with knee and hip arthroplasties. When a bone infection breaks through the outer cortex and into the intracapsular region, a joint infection may also occur, especially in children [5, 6].

Septic arthritis commonly presents with monoarticular joint pain with erythema, warmth, swelling, and pain on palpation and movement. Fever is present in many patients, 40% can present with high grade fever [7]. Risk factors associated with increased risk of joint damage include age more than 65 years, diabetes, and beta-hemolytic streptococci infection, whereas risk factors for morbidity include age more than 65 years, confusion at time of first presentation, and polyarticular involvement. Even experienced doctors find it hard to diagnose septic arthritis. However, symptoms as hot swollen joints are frequently presented to doctors who are unaware with the diagnosis, assessment, and management of joint disease. The optimal management of septic arthritis is a subject of considerable debate, especially after diagnosis, which is obtained mainly by presence of symptoms besides having a positive microbiological and/or blood culture [8].

Delayed or inadequate treatment of septic arthritis can lead to irreversible joint destruction with subsequent disability, and in addition there is significant mortality with an average estimated case fatality rate of 11%. It is therefore vital that the diagnosis is made rapidly and that treatment is started promptly [9, 10]. Management includes giving intravenous antibiotics and orthopedic surgery consult for operative management vs. serial aspirations [7].

Previous study indicates that doctors are responsible for identifing acute nontraumatic monoarticular arthritis etiology in most patients

within 3 days considering taking patient's history, making physical examination and synovial testing. The privilege of three-day for most monoarticular arthritis patients is often lacking for emergency physicians, and it is necessary to identify crucial diagnostic results to properly identify septic arthritis in within minutes to hours". So, this review aims to summarize current evidence regarding evaluation and management of septic arthritis in emergency department.

Causative Organism: The most common causative organism in both children and adult SA is Staphylococcus aureus. Mue, Dd et al. [11] reported that Staphylococcus aureus was the most organism found in (54.3%) of studied cases followed by E coli (20%) and Haemophillus influenza (2.8%) which agrees with previous series [12, 13]. A modern study of 165 cases of acute hematogenous osteomyelitis or septic arthritis treated in the years before and after the start of the Hib (H. influenzae b type) vaccine proved that musculoskeletal infections due to this bacterial species were decreased to nearly nonexistence levels [14]. Consequently, the coverage of H. influenzae as part of the empirical antibiotic coverage may no longer be needed in the management of acute septic arthritis in Hib (H. influenza type b)-vaccinated children. Whereas H. influenzae has lost its prevalence as the most commonly identified gram-negative pathogen in pediatric populations, the normal oropharyngeal resident of young children, Kingella kingae, may have taken its place, especially in patients younger than 2 years. In fact, a Lavy CBD, Lavy VR, Anderson I found that the nearly half of the clinical isolates from patients younger than 2 years with acute septic arthritis were K. kingae [15, 16].

Salmonella septic arthritis has been reported in some African series [17, 18]. The reason for the high prevalence of Salmonella in septic arthritis is probably because it is the single most prevalent organism found in the blood of sub-Saharan children. Most cases of Salmonella bacteraemia are found in children between 6 months and 5 years of age, with the highest incidence between the ages of 10 and 14 months. It is also strongly associated with anaemia, poor nutritional status and malaria [17, 18]. In a Zambian author's series all the 26 children with Salmonella septic arthritis were anaemic and all were underweight [17]. In adults, Salmonella septic arthritis is associated with systemic lupus erythematosis (SLE), liver disease, schistosomiasis and avascular necrosis [19]. Salmonellosis, osteomyelitis and joint infections are also common in sickle cell disease. The cause for this is probably the fact that intravascular sickling causes capillary occlusion, which devitalizes and possibly infarcts the gut, permitting salmonella invasion. Culture results revealed no growth in 8 (22.9%) cases. All of these patients were already on inappropriate parenteral or oral antibiotic prescribed by parents or other healthcare providers before presenting to the facility [20].

Although a significant number of patients have mild fever and may not develop localized heat and erythema around the affected joint.

Evaluation in ED: The typical presentation of acute nongonococcal septic arthritis includes recent onset of fever, malaise, and local findings of warmth, pain, swelling, and reduced range of motion in the affected joint. Fever (≥ 39oC) occurs in up to 58% of patients, and the absence of fever should not be relied on to exclude the diagnosis; however, up to 90% of patients have been shown to have fever of low-grade (≥ 37.5oC). A noteworthy number of patients have mild fever and may not develop localized heat and erythema around the affected joint [21].

Children who develop septic arthritis of the hip usually present with acute onset of hip joint pain. If they walk, they may be limping and resist weight bearing on their affected leg. Children who do not walk will lie in bed holding their hip in the maximum comforting position which is flexed and abducted. This is a position that let the hip capsule to be laxer, and accordingly, reduce any pressure from an intraarticular effusion that may be triggering pain. They are usually febrile. There may be a history of a recent oropharyngeal infection [22].

The physician should take a detailed history with special emphasis on determining the incidence of any risk factors. The process of differentiating a patient who presents with acute hip pain and has septic arthritis from those who have acute pain from transient synovitis of the hip is hard. The most definitive method of making this differentiation is the aspiration of the hip [23]. Blood and synovial fluid samples should be plated immediately on prewarmed chocolate agar whereas genitourinary, rectal, and pharyngeal samples should be plated on prewarmed Thayer-Martin or modified New York medium supplemented with suitable antibiotics. The plates should then be incubated at 37°C in a

humid 5% CO 2 environment within 15 min of sample harvest.

The Kocher Criteria for diagnosing septic arthritis of the hip can be used to determine if an aggressive approach to management of the patient should begin. The four criteria used in order of sensitivity in the Kocher criteria are, fever higher than 38.5 C (101.3 F), ESR more than 40. Weight-bearing status (non-weight bearing), and white blood cell (WBC) count more than 12,000. Children who meet one out of four of these criteria have a 3% incidence of septic arthritis, two out of four have a 40% incidence, three-quarters have a 93% incidence, and four out of four have a 99% incidence [24].

Laboratory Testing: Serum blood tests are insufficient to regulate septic arthritis. Synovial fluid is the gold-standard test for making the diagnosis and evaluation of septic arthritis. While a complete blood cell count, C-reactive protein (CRP), and erythrocyte sedimentation rate (ESR) are often acquired, the results of these tests will not adequately decrease the post-test probability to influence the decision to obtain synovial fluid. The serum white blood cell (WBC) count may be raised above 10 × 109/liters (L), but the sensitivity ranges from 42–90% with +LR of only 1.4 [25]. The sensitivity of ESR differs based on the specific cut-off value that is chosen, with a sensitivity of 66% for 15 mm/hr to > than 90% for 30 mm/hr. A meta-analysis study suggests a +LR of 1.3 for ESR > 30 mm/hr.9 CRP > 10 mg/L also has a sensitivity approaching 90%; however, a level of 100 mg/L has a poor +LR of 1.6. While procalcitonin demonstrates promise, at this time it needs further study before routine use. Blood cultures should be obtained in patients with septic arthritis, as they can help detect the source if the synovial fluid culture is negative. Blood cultures will be positive in over one-third of all patients, and 14% of patients with negative synovial fluid cultures will have positive blood cultures [26, 27].

Imaging: There are no data on imaging studies that are pathognomonic for acute septic arthritis. Plain films establish a baseline and may detect fractures, chondrocalcinosis, or inflammatory arthritis. Ultrasonography is more sensitive for detecting effusions, particularly in difficult-to-examine joints, such as the hip. Magnetic resonance imaging findings that suggest an acute intraarticular infection include the combination of bone erosions with marrow edema. Imaging may allow guided arthrocentesis, mainly in difficult-to-examine joints as hip, costochondral, and sacroiliac [28].

Synovial Fluid Analysis: The most useful diagnostic laboratory test for identifying septic arthritis is an evaluation of the synovial fluid from the affected joint (culture, crystals analysis, Gram stain, white blood cell count with differential). Synovial fluid with a white blood cell (WBC) count more than 50,000 and 90% neutrophil prevalence suggests a bacterial source. Identification of a bacterial organism in the synovial fluid approves the diagnosis [29]. Synovial polymorphonuclear cells (sPMN) can also be considerably higher in cases of septic arthritis. Unfortunately, this test does not considerably change probability of septic arthritis, with a +LR of 2.7 when the sPMN is > 90% and a −LR of 0.34 ,when the sPMN is < 90% [30, 31].

Other diagnostic assessments include synovial culture, Gram stain, protein, lactate dehydrogenase (LDH), glucose, and lactate. Synovial culture is the only important test and should be applied on all patients from whom synovial fluid is collected. Synovial fluid will show growth in almost 80% of all cases of nongonococcal septic arthritis [32]. The remaining 20% of negative cultures may show no growth for multiple reasons including small number of bacteria present in the joint space, obtaining a sample after beginning of antibiotics, wrong diagnosis of septic arthritis, poor sampling technique, or poor plating technique. To reduce the possibility of false negative synovial cultures, larger amounts of synovial fluid should be collected and sited in blood culture bottles [33]. Synovial Gram stain sensitivity ranges from 29–65% in cases of Gram-positive septic arthritis; however, this decreases to 40–50% in Gram-negative cases and 25% in gonococcal cases [34].

Management in ED: Rapid diagnosis and treatment decrease the risk of significant morbidity and mortality. Components of management include early detection and treatment, with antibiotics, joint aspiration, and orthopedic surgery consultation for probable operative management [35].

Antibiotic treatment: Due to the potential for rapid joint damage, broad-spectrum antibiotics are frequently needed. Empirical intravenous antibiotic treatment of septic arthritis should be based on the organism found in the Gram stain of the synovial fluid, or on the suspicion of a

pathogen from the patient's clinical findings [36]. The patient's history and clinical course often provide clues to differentiate between gonococcal, nongonococcal, and granulomatous arthritis. Treatment options include vancomycin for gram-positive cocci, ceftriaxone (Rocephin) for gram-negative cocci, and ceftazidime (Fortaz) for gram-negative rods. If the Gram stain is negative but there is suspicion of bacterial arthritis, vancomycin plus either ceftazidime or an aminoglycoside is appropriate. Adjustments to the administration route and the duration of treatment should be based on the clinical response and microbiology results [37, 38].

In patients with strong concern for septic arthritis or in those who are seriously ill, both Gram-negative and MRSA coverage is recommended with a combination of cefepime, or an antipseudomonal beta-lactam agent and vancomycin, respectively. If the patient is allergic to vancomycin, clindamycin, daptomycin, or linezolid may be used instead. Once the specific organism is confirmed, antibiotic therapy should be narrowed. There is currently no role for intra-articular antibiotics or intra-articular corticosteroids for these patients in the ED setting [39].

The common course of therapy for nongonococcal arthritis is 2 weeks for arthritis because of H. influenzae or Streptococcus spp. and 3 weeks for arthritis because of S. aureus or gram-negative bacilli. Initial antibiotic therapy in children younger than 5 years contains cefuroxime, cefotaxime, or ceftriaxone relying on the blood and joint culture results. Initial antibiotic therapy for patients older than 5 years is aided by the Gram stain, if clusters of gram-positive organisms indicative of S. aureus are seen; treatment with intravenous (i.v.) penicillinase-resistant penicillin should begun [40].

Table 5. Empiric Antibiotic therapy for suspected bacterial arthritis

Gram stain result	Antibiotic
Gram-positive cocci	Vancomycin
Gram-negative cocci	Ceftriaxone (Rocephin)
Gram-negative rods	Ceftazidime (Fortaz), cefepime (Maxipime), piperacillin/tazobactam (Zosyn), or carbapenems if patient is allergic to penicillin or cephalosporins: aztreonam (Azactam) or fluoroquinolones
Negative Gram stain	Vancomycin plus either ceftazidime or anaminoglycoside

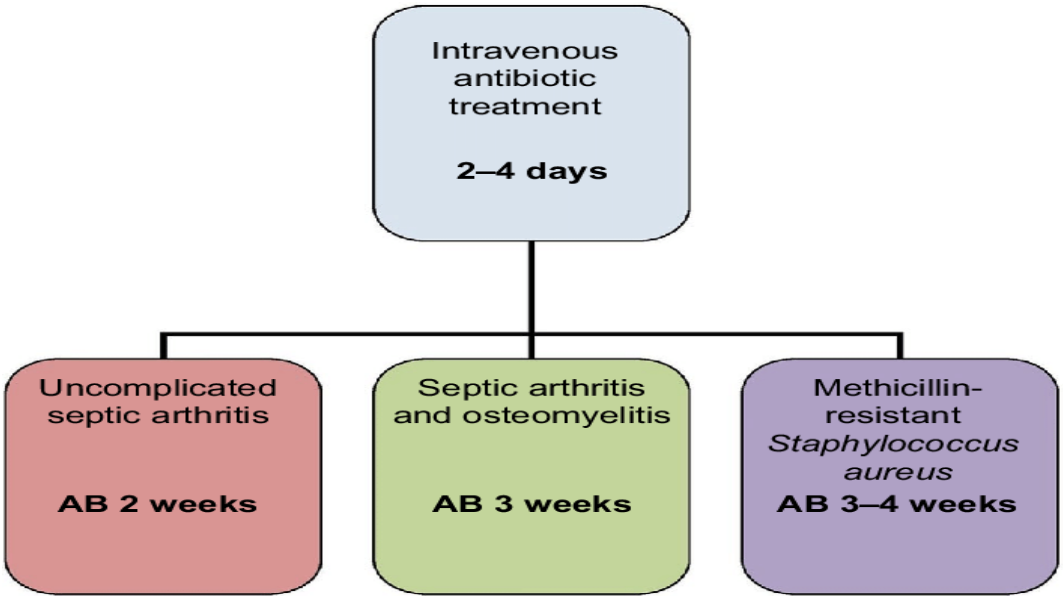

Fig. 1. Demonstrates the suggested treatment

Joint Aspiration: Patients should be firstly treated with needle aspiration if a joint infection is easily manageable, if the vast majority of the purulent fluid can be removed, and if the patient does not suffer from negative prognostic indicators. Most joint aspirations are within the purview of the emergency physician [41]. While it is traditionally recommended to avoid aspirating through a site with overlying cellulitis, one recent review suggests there was no harm from aspirating through cellulitis, with the only direct definitive contraindication an underlying abscess. Additionally, anticoagulation is a relative contraindication, but should be weighed against the much elevated risk associated with missing a case of septic arthritis [42].

Prosthetic joints should be discussed with orthopedic surgery prior to aspiration. If incapable of obtaining fluid on the first aspiration, several techniques may be utilized to increase the possibility of success. Utilizing a larger gauge needle and a smaller syringe can improve the ability to obtain fluid by producing a greater pressure difference. Furthermore, compression of the contralateral side of the joint with moderate rotation of the needle while aspirating will be beneficial. Lastly, ultrasound should be considered for arthrocentesis, as it locates the area with maximal fluid, while avoiding vascular structures and tendons [43, 44].

Frequent needle aspiration for recurrent joint effusions has been used successfully during the first 7 days of treatment. If the volume of synovial fluid, the cell count, and the percentage of polymorphonuclear leukocytes decrease with each aspiration, then the combination of antimicrobial therapy and aspiration as needed is possibly sufficient [45].

Surgical Management: Referral from ED to orthopedic surgeon is critical in some cases. There is a diversity of methods to drain the purulent fluid from the affected joint. Presented in ascending order of invasiveness, cost, and effectiveness in the thoroughness of drainage, they include needle aspiration, tidal irrigation, arthroscopy, and arthrotomy. There is no set of commonly accepted criteria for selecting the drainage method. It is agreed that the particular method of drainage used should be tailored to the clinical situation of the patient. However, some general guidelines can be listed [46].

Persistence of effusion beyond 7 days is evidence that arthroscopy or open drainage should be done. Tidal irrigation is as effective as arthroscopy and can be performed at the bedside. This closed-system irrigation method may be of use when needle aspiration results in incomplete evacuation or when multiple synovial fluid samples show different characteristics, indicating the presence of loculating pockets of infection. Arthroscopic lavage has been increasingly utilized in the therapy of septic arthritis of the knee [47].

Arthrotomy should be utilized when an infected joint must be decompressed immediately because of neuropathy or compromised blood supply, when the affected joint is distant by less invasive methods (such as the hip and sometimes the shoulder), when the joint has been injured by preexisting disease, when bacterial arthritis is complicated by osteomyelitis, and when the less aggressive methods of treatment fail [48]. Also, when the isolated pathogen (e.g., P. aeruginosa) can be treated only with aminoglycosides, arthrotomy is often necessary to overcome the low oxygen tensions and pH of the affected joint. A number of patient factors have also been implicated as negative prognostic indicators in septic arthritis and may increase the need for invasive surgical operation [49]. Some of these factors comprise a long duration between symptom onset and treatment, complicated joint site, extremes of age, underlying illness, immunosuppressive drugs, underlying joint diseases, presence of juxta-articular osteomyelitis, and chronic failure of less invasive methods to clear the infection as confirmed by positive blood or synovial fluid cultures, sustained back pain, and restriction of motion [50].

2. CONCLUSION

Septic arthritis is a medical emergency that can lead to significant morbidity and mortality. Therefore, prompt recognition and rapid, and aggressive treatments are critical to ensuring a good prognosis. The treatment of this form of septic arthritis includes both appropriate antimicrobial treatment and joint drainage. More ED-based septic arthritis diagnostic and therapeutic trials are required.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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