

7. The proposed definition was developed and validated on both PJI cases of the knee and the hip. While several publications have noted differences in the thresholds for synovial markers in PJI cases of the hip and the knee, we believe the differences are minor. Thus, the new definition has not made a distinction between hip and knee PJI. Nevertheless, future studies should explore such potential difference between these two joints.
8. Newer markers, such as the serum D-dimer, have not been sufficiently studied and while we had sufficient data to analyze the new markers and include them in the definition – more work is needed to further validate their role in the diagnosis of PJIs. Moreover, their role and thresholds in diagnosing acute PJIs still remains unknown.
9. In patients with adverse local tissue reactions (ALTRs), crystalline deposition arthropathy, inflammatory arthropathy flares, infections with slow-growing organisms and patients under antibiotic treatment, the proposed criteria may be inaccurate.
10. There may be other situations when a patient is infected and does not meet the diagnostic criteria and vice versa. Clinical judgment should still prevail and guide physicians in the management of patients.

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Authors: Douglas Dennis, Ali Parsa, José Ricardo Pécora

QUESTION 2: What is the definition of septic arthritis in a native knee?

RECOMMENDATION: Native septic arthritis of the knee is a clinical diagnosis supplemented by relevant laboratory data. Signs of septic arthritis include painful effusion, limited range of motion and warmth. Elevated serum inflammatory markers, particularly C-reactive protein (CRP), synovial white blood cell (WBC) counts (50,000 cells/mm³), polymorphonuclear (PMN) cell count percentages (> 90%) and purulent appearance of the synovial fluid indicate a high likelihood of septic arthritis.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 92%, Disagree: 7%, Abstain: 1% (Super Majority, Strong Consensus)

RATIONALE

Native septic arthritis of the knee classically presents with a painful effusion and limited range of motion. Diagnosis of this clinical entity cannot be made on the basis of laboratory data alone, with infections occurring in the presence of negative cultures and absent in the presence of markedly elevated intra-articular cell counts [1]. The frequency of native knee septic arthritis appears to be increasing and major concerns for serious medical complications and mortality persist [2]. The most robust information on laboratory data diag-

nostic for septic arthritis is available for the pediatric hip joint [3,4]. However, such high-quality, algorithmically predictive data is lacking for the adult native knee joint.

Septic arthritis in the knee remains a challenging diagnosis to make due to similarities to other entities in clinical presentation and equivocal laboratory results. Clinical impression remains the mainstay of diagnosis, but should be supplemented by relevant laboratory data. Screening inflammatory markers, particularly a

CRP, should be obtained and suspicion for infection should always be kept to avoid missing a diagnosis. Aspiration of the knee should be completed prior to administration of antibiotics when clinically feasible to increase diagnostic accuracy. Synovial cell counts greater than 50,000 cells/mm³ and/or PMN cell count percentages greater than 90% indicate a high likelihood of septic arthritis [5].

Laboratory data obtained where clinical suspicion for septic arthritis exist includes serum erythrocyte sedimentation rate (ESR) and CRP. While lacking specificity, a CRP elevated above 10.5mg/dL has been demonstrated to show a high correlation with septic arthritis in native joints in the appropriate clinical scenario [6]. A study by Hügle et al. also indicates that procalcitonin (PCT) is useful for establishing the presence of infection and may have superior sensitivity and specificity than CRP in detecting septic arthritis [7].

Aspiration is a critical portion in evaluating the possibility of native knee septic arthritis. Numerous studies and a meta-analysis have shown higher synovial WBC counts more likely to represent infection [8] and greater percentage of PMN cells (> 90%) highly predictive of septic arthritis [5]. Traditional teaching held that cell counts could be divided into non-inflammatory, inflammatory and infectious, corresponding to 0 to 2,000 cells/mm³, 2000 to 50,000, and >50,000, respectively. However, one investigation showed only 64% sensitivity of using this infectious cell count cutoff, with approximately one-third of patients with septic arthritis having a cell count lower than 50,000 [9]. Therefore, infection can also be present with lower cell counts and gross inspection of the fluid can be as valuable as the cell count in determining infectious pathology of an effusion [10,11]. In particular, synovial WBC count more than 50,000 and percentage of PMN more than 90% provide adequate concern to identify septic arthritis while waiting for culture test results [5].

A native knee aspiration resulting in a false positive culture is rare if done under proper technique. Jennings et al. demonstrated a false positive rate of 0% of 166 knees in their series using appropriate sterile technique [12]. Therefore, positive cultures obtained using such technique should raise the alarm for the high likelihood of a real infection. Administration of antibiotics prior to obtaining an aspiration has been shown by Hindle et al. to decrease the yield for culture and to reduce its accuracy from 79 to 28%, and should be avoided when feasible [13]. The available literature suggests that Staphylococcal species are the most common causative organisms for septic arthritis of the knee in an adult, followed by other gram-positive cocci and gram-negative bacilli [2,14]. However, septic arthritis by other atypical organisms can occur and this needs to be kept in mind when investigating patients with suspected septic arthritis.

The leukocyte esterase (LE) test is used commonly for diagnosis of infections in different organs [15]. In a recent prospective study of 27 cases of acute monoarticular arthritis in major joints, Gautam et al. reported a 100% sensitivity of the LE test in the diagnosis of septic arthritis when +2 was considered indicative of a positive result. The positive predictive value in their series was 94% and only one synovial sample was LE positive despite negative culture results. They concluded that this test could efficiently differentiate other etiologies of inflammatory acute arthritis from septic arthritis [6]. Another study by Ceja-Picazo et al. had almost identical findings and supported the use of LE dip stick in investigation of patients with painful knee and suspected of septic arthritis, as it was able to differentiate osteoarthritic from infected knees [16].

The role of molecular techniques such as polymerase chain reaction (PCR) has been previously investigated in the diagnosis of septic arthritis. The studies have found that PCR may not provide additional data to culture in investigation of these patients [17]. However, as time has progressed and technology has improved, molecular techniques are likely to play a critical role in the diagnosis of orthopaedic infections in general and septic arthritis in particular [18,19]. The newer molecular techniques such as next generation sequencing, because of the rapid decline in DNA sequencing costs, are likely to be even more beneficial in the investigation of patients with orthopaedic infections. These tests will result in a notable decrease in time to diagnose the condition and to isolate the causative organism.

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