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Commentary

Assessment of a New Test in Diagnosing Pediatric Septic Arthritis

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Background

Septic arthritis is responsible for 8-27 percent of monoarticular arthritis cases with a mortality rate of 11% in culture-positive patients (1). Failure to diagnose septic arthritis in a timely fashion will result in irreversible joint damage, leg length discrepancy (LLD), osteomyelitis, and pathological fractures (2). A false diagnosis, on the other hand, will subject the patient to unnecessary invasive procedures. Therefore, efforts have been focused on making an early and accurate diagnosis and prompt treatment.

Kocher et al. proposed a scoring system by which one could differentiate between pediatric septic arthritis and transient synovitis. Kocher's criteria, which are still commonly used to diagnose septic arthritis, include non-weight bearing on the affected limb, erythrocyte sedimentation rate (ESR) > 40 mm/hour, temperature > 38.5 °C, and white cell count (WCC) > 12×10^3 per ml. With all four criteria present, there is a 99.6% probability of septic arthritis (3). However, diagnosing a septic joint is not as straightforward when two or three criteria are present or in neonates where the absence of all four criteria does not rule out septic arthritis (4). Attempts have been made in order to increase Kocher's criteria sensitivity; some authors added C-reactive protein (CRP) levels to the scoring system (3, 5). When septic arthritis is highly suspected, diagnostic arthrocentesis is usually performed to test the synovial fluid (SF) using Gram staining, culture, and cytology. Li et al. reported that a combination of SF white blood cell (WBC) count and blood ESR and CRP levels could achieve 100% sensitivity for the diagnosis of septic arthritis, though the specificity was only 24% (6).

The current diagnostic approach has several limitations. In suspected septic arthritis, timely diagnosis is critical and the clinician ought to act before joint destruction begins. Therefore, SF analysis, which can take hours to be completed even in the most experienced centers, cannot be relied upon. Also, the SF Gram stain has a low sensitivity (7). Even the widely-used Kocher's criteria have their own drawbacks and their predicted probability varies in different studies, populations, and centers (3, 5, 8-10). This is why in most centers, clinicians rely on a combination of symptoms, physical examination, and lab results when faced with suspected septic arthritis.

Leukocyte esterase (LE) strip test is routinely used to detect the presence of WBCs in the urine and to diagnose urinary tract infections (UTIs). More recent studies have expanded the use of the LE strip to detect other infections such as pleural effusion and amniotic fluid infections. It can detect the presence of both intact and lysed WBCs (11). LE strip is an inexpensive test and the result can be available as fast as within two minutes. The color on the strip is compared to the chart provided by the manufacturer and the results are described qualitatively as negative to (+++) (12).

Two studies have investigated the role of LE strip in the diagnosis of periprosthetic joint infections (PJIs) and reported high positive predictive values with a (++) or (+++) result (13, 14). In another study, Colvin et al. showed that negative predictive value of LE strip test was as high as 100% in infection of both native and periprosthetic joints in adults (12). This was the first study to investigate the role of the LE strip test in diagnosing pediatric septic arthritis. There is also a paucity of literature on reaction of LE strip test to non-infected SF.

Mortazavi et al. have recently performed an investigation on the characteristics of the LE strip test in diagnosing pediatric septic arthritis. They also evaluated test characteristics in non-septic SF. In their study, they have tested SF of 25 cases with suspected septic arthritis in their center with LE strip test and with the test being fast, easy, and cheap with sensitivity of 100% and also a negative predictive value of 100%, a high specificity of 86%, and a positive predictive value of 95%, they have concluded that LE strip test can be used as a reliable tool in addition to other criteria in early diagnosis of septic arthritis in children (15).

Discussion

Unfortunately, there are no universally-accepted criteria for diagnosing pediatric septic arthritis. Based on previous studies, Mortazavi et al. determined criteria for septic arthritis in their study as follows: positive SF culture, finding bacteria in SF smear, or SF WBC count more than 50000 cell/mm^3 (15). Before this study, there were few studies in the literature that considered the presence of obvious purulent SF as a criterion for septic arthritis. The authors have mentioned that due to the high prevalence of antibiotic-treated patients in a referral hospital, they would have missed many patients with the

conventional criteria. In their patient population, 18 out of 19 children underwent an arthrotomy based on obvious pus coming out of the joint at the time of arthrocentesis and 1 based on positive bacterial smear.

The aforementioned study has also raised a question about the actual cut-off for CRP, and especially SF WBC in children with suspected septic arthritis. Previous studies have shown that SF WBC more than 50000 cell/mm^3 and a CRP higher than 20 mg/dl should be considered as positive indicators for septic arthritis in children, but in this study, the cut-off was found to be 10200 cell/mm^3 for SF WBC and 47 mg/dl for CRP. Although, with small number of total cases, both SF WBC and CRP were statistically significant, the authors stated that the SF WBC could be influenced by the antibiotic treatment, as noted in previous studies (11). They also have found that the percentage of SF polymorphonuclear (PMN) leukocytes in children with septic arthritis is significantly higher (91% vs. 53%); there were no other studies in this specific subject to compare this finding with.

This was the first study to evaluate the value of LE strip test in diagnosing pediatric septic arthritis. According to Mortazavi et al., this test has a high sensitivity (100%), specificity (83%), and accuracy (96%). However, this study had some limitations that were mentioned by authors, including considerably small sample size, the inability of LE strip test to diagnose patients with gonococcal or Lyme-induced septic arthritis which can be treated non-operatively, and the history of pre-admission antibiotic use in all of the patients. They addressed these issues separately in their discussion. One may notice that there are two groups in this study: the main group contained patients with suspected septic arthritis and the other one was the "developmental dysplasia of the hip (DDH) group", which was designed to determine the number of false positive cases in non-septic joints. But according to the authors, it should be elucidated that the study was not designed as a case-control study and it is actually a validity test study, in which one evaluates the characteristics of a test in different conditions. In addition to determining LE strip test characteristics in suspected joint fluid, authors claimed that they had also determined the number of false positive tests in children with non-septic and non-inflammatory joints, as there were no studies to evaluate this matter according to the authors (15).

In conclusion, the promising results of the mentioned study introduce a new, easy, fast, and cheap method. Future multicenter studies with larger patient populations can provide a better understanding of the role and characteristics of this test in early diagnosis of septic arthritis in children.

Conflict of Interest

The authors declare no conflict of interest in this study.

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References

1. Gupta MN, Sturrock RD, Field M. A prospective 2-year study of 75 patients with adult-onset septic arthritis. *Rheumatology (Oxford).* 2001;40(1):24-30. doi: 10.1093/rheumatology/40.1.24. [PubMed: 11157138].
2. Sukswai P, Kovitvanitcha D, Thumkunanon V, Chotpitayasunondh T, Sangtawesin V, Jeerathanyasakun Y. Acute hematogenous osteomyelitis and septic arthritis in children: Clinical characteristics and outcomes study. *J Med Assoc Thai.* 2011;94(Suppl 3):S209-S216. [PubMed: 22043778].
3. Kocher MS, Zurakowski D, Kasser JR. Differentiating between septic arthritis and transient synovitis of the hip in children: An evidence-based clinical prediction algorithm. *J Bone Joint Surg Am.* 1999;81(12):1662-70. doi: 10.2106/00004623-199912000-00002. [PubMed: 10608376].
4. Mitha A, Boulyana M, Hue V, Pruvost I, Martinot A, Dubos F. Consensus in diagnostic definitions for bone or joint infections in children by a Delphi method with European French-speaking experts. *Acta Paediatr.* 2012;101(8):e350-e356. doi: 10.1111/j.1651-2227.2012.02716.x. [PubMed: 22578155].
5. Kocher MS, Mandiga R, Zurakowski D, Barnewolt C, Kasser JR. Validation of a clinical prediction rule for the differentiation between septic arthritis and transient synovitis of the hip in children. *J Bone Joint Surg Am.* 2004;86(8):1629-35. doi: 10.2106/00004623-200408000-00005. [PubMed: 15292409].
6. Li SF, Cassidy C, Chang C, Gharib S, Torres J. Diagnostic utility of laboratory tests in septic arthritis. *Emerg Med J.* 2007;24(2):75-7. doi: 10.1136/emj.2006.037929. [PubMed: 17251607]. [PubMed Central: PMC2658211].
7. Faraj AA, Omonbude OD, Godwin P. Gram staining in the diagnosis of acute septic arthritis. *Acta Orthop Belg.* 2002;68(4):388-91. [PubMed: 12415942].
8. Luhmann SJ, Jones A, Schootman M, Gordon JE, Schoenecker PL, Luhmann JD. Differentiation between septic arthritis and transient synovitis of the hip in children with clinical prediction algorithms. *J Bone Joint Surg Am.* 2004;86(5):956-62. doi: 10.2106/00004623-200405000-00011. [PubMed: 15118038].
9. Yagupsky P, Dubnov-Raz G, Gene A, Ephros M. Differentiating Kingella kingae septic arthritis of the hip from transient synovitis in young children. *J Pediatr.* 2014;165(5):985-9. doi: 10.1016/j.jpeds.2014.07.060. [PubMed: 25217199].
10. Sultan J, Hughes PJ. Septic arthritis or transient synovitis of the hip in children: The value of clinical prediction algorithms. *J Bone Joint Surg Br.* 2010;92(9):1289-93. doi: 10.1302/0301-620X.92B9.24286. [PubMed: 20798450].
11. Omar M, Ettinger M, Reichling M, Petri M, Lichtinghagen R, Guenther D, et al. Preliminary results of a new test for rapid diagnosis of septic arthritis with use of leukocyte esterase and glucose reagent strips. *J Bone Joint Surg Am.* 2014;96(24):2032-7. doi: 10.2106/JBJS.N.00173. [PubMed: 25520336].
12. Colvin OC, Kransdorf MJ, Roberts CC, Chivers FS, Lorans R, Beauchamp CP, et al. Leukocyte esterase analysis in the diagnosis of joint infection: Can we make a diagnosis using a simple urine dipstick? *Skeletal Radiol.* 2015;44(5):673-7. doi: 10.1007/s00256-015-2097-5. [PubMed: 25626524].
13. Parvizi J, Zmistowski B, Berbari EF, Bauer TW, Springer BD, Della Valle CJ, et al. New definition for periprosthetic joint infection: From the Workgroup of the Musculoskeletal Infection Society. *Clin Orthop Relat Res.* 2011;469(11):2992-4. doi: 10.1007/s11999-011-2102-9. [PubMed: 21938532]. [PubMed Central: PMC3183178].
14. Wetters NG, Berend KR, Lombardi AV, Morris MJ, Tucker TL, Della Valle CJ. Leukocyte esterase reagent strips for the rapid diagnosis of periprosthetic joint infection. *J Arthroplasty.* 2012;27(8 Suppl):8-11. doi: 10.1016/j.arth.2012.03.037. [PubMed: 22608686].
15. Mortazavi SMJ, Kalantar H, Baghdadi S, Nabian MH, Haj ZR, Riahi A, et al. The utility of leukocyte esterase strip test in the diagnosis of pediatric septic arthritis. *J Pediatr Orthop.* 2020;40(4):e312-e316. doi: 10.1097/BPO.0000000000001413. [PubMed: 31157752].