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Clinical Decision Tool Reviews

Updated Review of the Caird-Modified Kocher Criteria for Septic Arthritis

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Abstract

The Kocher criteria were derived to help differentiate septic arthritis of the hip in children from transient synovitis. Caird modified the criteria (making the so-called "Modified Kocher Criteria") by including C-reactive protein > 2.0 mg/dL as a criterion and found similar test characteristics. These rules are sometimes used to determine risk of septic arthritis of the knee, but this should be done with great caution, as they were not validated for use in the knee, and studies evaluating the performance of the criteria for septic arthritis of the knee demonstrate poorer test characteristics.

I. HOW TO USE

When to Use

The Kocher criteria (1999) were derived to help differentiate septic arthritis of the hip in children from transient synovitis. Caird modified the criteria (making the so-called "Modified Kocher Criteria") by including C-reactive protein > 2.0 mg/dL as a criterion and found similar test characteristics (2006). These rules are sometimes used to determine risk of septic arthritis of the knee, but this should be done with great caution, as they were not validated for use in the knee, and the modified Kocher criteria may miss a high percentage of patients with septic knee.

Pearls / Pitfalls

Patients falling on either extreme of the criteria (having no criteria or all criteria) can be more readily ruled in or out for septic arthritis in the right clinical setting. Patients in the intermediate range may need further work-up, expert consultation with a pediatric orthopedic surgeon, or intervention.

Criteria did not perform as well in the validation study though may still be clinically useful for those on either extreme of the scale.

While some use the Kocher and Modified Kocher criteria to determine the likelihood of septic arthritis of the knee, the model was only validated using cases of septic arthritis of the hip. The test characteristics for the (Modified) Kocher criteria are less favorable when applied to the knee; use in this context should be done with caution.

Persistent concern for septic arthritis should warrant orthopedic consultation, regardless of Kocher score.

Why Use

Differentiating septic arthritis and transient synovitis of the hip in children can be difficult given their similar, non-traumatic presentations (Child refusing to bear weight with limited motion at hip without history of trauma with and without fever). The Kocher criteria can identify particular subsets of patients who need urgent orthopedic consultation or can be observed without aspiration.

II. NEXT STEPS

Advice

Obtain a thorough history and physical exam on all pediatric patients presenting with an acutely irritable hip, paying particular concern to presence or history of fever and inability to bear weight. Draw a blood culture, Complete Blood Count (CBC), Erythrocyte Sedimentation Rate (ESR) and C-Reactive Protein (CRP) in all patients with a clinical concern for septic arthritis or transient synovitis. Blood cultures should be held for at least 5 days to screen for the growth of Kingella kingae, which grows slower but is a rising cause of septic arthritis particularly in younger children. The differential diagnosis for limp or joint pain in a child is broad and may also include Legg Perthes Disease, Juvenile Rheumatoid arthritis, Psoas Abscess, Sacroiliitis, acute leukemia, osteomyelitis, and myositis. Evaluation for these and other conditions should be considered.

Management

Septic arthritis is a surgical emergency. . If there is a high clinical suspicion do not delay orthopedic consultation. According to Kocher, presence of 3 or 4 predictors may require aspiration in the operating room, child with only 2 predictors may be a good candidate for aspiration by ultrasound/fluoroscopy, while a child with 0 predictors may be observed without aspiration.

Consider observation and/or discharge with close follow-up in well-appearing patients with a low clinical suspicion for septic arthritis and no predictors present.

Critical Actions

Patients meeting no Kocher criteria can potentially be discharged (0 predictors), while those meeting all criteria require urgent orthopedics consultation for washout (4 predictors). Those with some predictors may require hip arthrocentesis.

The criteria are less useful in intermediate risk cases. If septic arthritis is still being considered, a pediatric orthopedic consultation should be obtained.

Children with suspected sepsis should be treated according to local protocols. Antibiotics should not be delayed in order to acquire a synovial fluid sample if the child is ill-appearing or unstable.

III. EVIDENCE

Evidence Appraisal

Original derivation study published in 1999

Kocher et al performed a retrospective chart review of 282 patients who were evaluated between 1979 and 1996 for an acutely irritable hip for which the differential diagnosis included transient synovitis and septic arthritis.

The septic arthritis groupwas diagnosed with positive joint fluid culture or > 50,000 WBCs/mm3 in aspirated joint fluid (n=82) included 38 patients with "true" septic arthritis (positive joint culture or Joint Fluid Aspirate (JFA) white count >50,000 WBCs/mm3 and positive blood culture) and 44 presumed septic arthritis (synovial fluid with >50,000 WBCs/mm3 with negative joint fluid and blood cultures). These patients were compared with 86 children diagnosed with transient synovitis (<50,000 WBCs/mm3 with negative joint fluid culture and resolution of symptoms without antimicrobial therapy).

Eighty-two patients were diagnosed with septic arthritis, while 86 were diagnosed with transient synovitis (<50,000 WBCs/mm3 with negative joint fluid culture and resolution of symptoms without antimicrobial therapy).The authors found four independent multivariate predictors for differentiation between septic arthritis and transient synovitis: history of fever, non-weight-bearing status, ESR > 40 mm/hour, serum WBC > 12,000. The probability for septic arthritis was based on the number of predictors being present. Zero predictors: < 0.2% risk, 1 predictor: 3.0%, 2 predictors: 40%, 3 predictors: 93.1%, 4 predictors: 99.6%. That study found a favorable AUROC of 0.96. A prospective validation study done by Kocher had a AUROC of 0.86 with 93% probability in presence of 4 predictors (Kocher, J Bone Jt Surg Am, 2004, 86, 1629-1635)

Outside groups have retrospectively applied the Kocher criteria to their populations and found that having all four predictors yielded a probability for septic arthritis of just 59% (Luhmann 2004). They did not publish its rate of septic arthritis when no predictors were present. Another group did the same retrospective application of the ModifiedKocher criteria (including CRP) and found a predicted probability of 59.9% when all five predictors were present (Sultan, 2010).

One study only had five patients with septic arthritis. No patients had septic arthritis with no predictors present. These studies have often applied the Kocher criteria to non-hip joints including Knee joints and most of them have failed to validate its application to joints other than hip. One study reporting that up to 52% of septic knees can be missed with the modified Kocher criteria (Obey, 2019) and used different outcome measures, meaning that the original studies have not been as well validated in recent years (also see Valisena et al., 2024 for a review).

A further criticism is that both the Kocher and Caird-Modified criteria were derived in an era when Kingella kingae was just beginning to emerge as a known (and now relatively common) cause of septic arthritis in children. Children with K kingae infections tend to present more mildly, meeting fewer Kocher criteria while still having septic arthritis. The organism is also more difficult and slower to grow in culture. (see Valisena S, De Marco G, Vazquez O, Cochard B, Steiger C, Dayer R, Ceroni D. The Kocher-Caird Criteria for Pediatric Septic Arthritis of the Hip: Time for a Change in the Kingella Era? Microorganisms. 2024 Mar 10;12(3):550. doi: 10.3390/microorganisms12030550. PMID: 38543601; PMCID: PMC10974044.)

Validation study in 2004

Kocher and colleagues applied their criteria prospectively to children who presented in a single center emergency department with "acutely irritable hip" between 1997 and 2007. Only patients on whom joint aspiration was performed were included. In this validation study, 24 patients met the criteria for true septic arthritis, 27 were presumed to have septic arthritis and 103 diagnosed with transient synovitis based on the criteria in the original study. The true and presumed septic arthritis group were combined together for analysis. In this validation study, the AUROC of the four predictor model was 0.86.The criteria of Kocher et al. were prospectively applied to pa-

tients presenting to a major tertiary-care children's hospital between 1997 and 2002 with an acutely irritable hip. The validation cohort included 213 consecutive patients, 51 of whom were diagnosed with septic arthritis and 103 with transient synovitis. Probability for septic arthritis was again based on the number of predictors present.

Zero predictors: 2.0% risk,
1 predictor: 9.5%,
2 predictors: 35.0%,
3 predictors: 72.8%,
4 predictors: 93.0%.

"Modified" criteria (Caird) in 2006

Caird's study added CRP (> 2.0 mg/dL or 20 mg/L) as a criterion in addition to the 4 original Kocher et al. criteria. This was a prospective single centercohort study (2000-2004)performed over a 4 year period and analyzed 48 patients who underwent hip aspiration. Children with immunosuppressive disease, a prior diagnosis of inflammatory arthritis were excluded. Having 0 risk factors was associated with a 16.9% risk of septic arthritis, which was significantly higher than the study by Kocher et al (0.2). Having all 5 risk factors was associated with a septic hip probability of 97.5%. Having 4 of 5 risk factors conferred a 93.1% probability.

Both the Kocher and Caird studies only applied the criteria on patients whose clinical presentation was suspicious enough to require joint aspiration, thus leading to high pretest probability of disease. Validation studies including all patients presenting with hip pain have performed poorly.

The modified Kocher criteria are commonly applied to children with suspected septic hip, and sometimes to non-hip joints, but they have not been formally externally validated.

Formula

Series of Yes/No questions, each "Yes" increases the risk likelihood of septic arthritis (see below).

Facts & Figures Original Kocher criteria:
0 criteria - 0.2% probability for septic arthritis
+ 1 criterion - 3% probability for septic arthritis
+ 2 criteria - 40% probability for septic arthritis
+ 3 criteria - 93% probability for septic arthritis
+ 4 criteria - 99.6% probability for septic arthritis
Modified Kocher criteria:
0 criteria - 16.9% probability for septic arthritis
1 criterion - 36.7% probability for septic arthritis
2 criteria - 62.4% probability for septic arthritis
3 criteria - 82.6% probability for septic arthritis
4 criteria - 93.1% probability for septic arthritis
5 criteria - 97.5% probability for septic arthritis

Literature Original/Primary

https://www.ncbi.nlm.nih.gov/pubmed/10608376

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Validation

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