Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/td1m7915

"CLINICO-LABORATORY PROFILE OF PEDIATRIC SEPTIC ARTHRITIS AND ITS DIFFERENTIATION FROM TRANSIENT SYNOVITIS: A RETROSPECTIVE STUDY"

Dr Satendra Singh Rajput [1], Dr Priyanka Rajput [2], Dr Ritesh Singh Yadav [3], Dr Ramniwas. Mahore [4*]

[1]Assistant professor , Department of pediatrics , Gajra Raja Medical College, Gwalior.
[2]Demonstrator, Department of Physiology , Gajra Raja Medical College, Gwalior.
[3]Assistant Professor, Department Of Orthopaedic , Index Medical College Malwanchal University, Indore.
[4*]Assistant Professor, Community Medicine Department, Gajra Raja Medical College, Gwalior.

***Corresponding Author:** Dr Ramniwas. Mahore
*E-mail: drmahore@gmail.com

Abstract

Background: Differentiating pediatric septic arthritis (SA) from transient synovitis (TS) is a critical diagnostic challenge. This study evaluated the clinico-laboratory profiles of both conditions and the performance of the Kocher criteria in a tertiary care setting in Central India.

Methods: This retrospective observational study (October 2021–September 2022) included 30 pediatric patients (SA: n=12; TS: n=18). Demographic, clinical, laboratory (WBC, ESR, CRP), and microbiological data were analyzed. The Kocher criteria were retrospectively applied, and statistical significance was set at $p < 0.05$.

Results: SA patients were significantly younger (3.4 vs. 5.8 years, $p < 0.05$). High-grade fever (83.3% vs. 16.7%) and non-weight-bearing status (91.7% vs. 38.9%) were significantly more prevalent in SA ($p < 0.01$\$). Inflammatory markers were markedly higher in SA: WBC (14,500 vs. 9,200 cells/mm³), ESR (52 vs. 18 mm/hr), and CRP (64 vs. 12 mg/L) ($p < 0.001$\$). *Staphylococcus aureus* was the most common pathogen (75% synovial fluid culture positivity). SA probabilities using Kocher criteria were 3%, 38%, 91%, and 98% for 1, 2, 3, and 4 predictors, respectively.

Conclusion: A multiparametric approach using clinical features, inflammatory markers (especially CRP and ESR), and the Kocher criteria reliably differentiates SA from TS. Early empirical anti-staphylococcal therapy is vital. The Kocher criteria remain a robust tool for resource-limited settings.

Keywords; *Septic arthritis, Transient synovitis, Kocher criteria, Paediatric joint infection, C-reactive protein, Staphylococcus aureus, Synovial fluid analysis*

Introduction

Septic arthritis (SA) is a serious bacterial infection of the joint space that constitutes a true orthopaedic emergency in the paediatric population. [1] The overall incidence of acute SA in children is estimated to be 4–20 cases per 100,000 children annually, with significant morbidity and a reported mortality rate of up to 11% in severe cases.[2] SA in children is predominantly hematogenous in origin, more commonly affects boys, and most frequently involves large joints of

the lower limb, particularly the hip and knee.[3] *Staphylococcus aureus* remains the most prevalent causative pathogen across all age groups, and early identification of the organism is critical to guide appropriate antimicrobial therapy.[4]

The clinical spectrum of paediatric SA is broad, ranging from subtle joint discomfort to florid systemic sepsis with high-grade fever, restricted limb movement, and inability to bear weight.[3] When diagnosis and surgical drainage are delayed, the consequences can be catastrophic-including irreversible cartilage destruction, growth plate damage, avascular necrosis of the femoral head, and long-term limb-length discrepancy. Studies have shown that subcartilaginous bone loss and joint dysfunction can occur if appropriate antibiotic therapy is not initiated within 24–48 hours of symptom onset.[5,6] Concomitant osteomyelitis further compounds the risk of adverse outcomes, underscoring the need for prompt and accurate diagnosis.[7]

A major diagnostic challenge arises from the clinical similarity between SA and transient synovitis (TS), the latter being the most common cause of acute hip pain in children aged 3–10 years.[8] TS is a self-limiting, non-infectious inflammatory condition of the joint synovium with an estimated annual incidence of 0.2% and a lifetime risk of approximately 3%. Like SA, TS presents with spontaneous hip or groin pain, limp, limited range of motion, and joint effusion on ultrasonography.[9] However, TS resolves without antibiotics or surgical intervention, making an erroneous diagnosis of SA — and the resulting unnecessary surgery — equally undesirable.[10]

Several laboratory and clinical parameters have been evaluated to aid in differentiating these two conditions. Kocher et al.,[11] in their landmark retrospective study, identified four independent clinical predictors of SA: fever (temperature ≥38.5°C), non-weight-bearing status, erythrocyte sedimentation rate (ESR) ≥40 mm/hr, and serum white blood cell (WBC) count ≥12×10⁹/L. When all four predictors were present, the predicted probability of SA was estimated at 99.6%. Subsequently, Singhal et al.[12] demonstrated that C-reactive protein (CRP) >20 mg/L was the strongest independent predictor of SA, with a multivariable model showing that weight-bearing status and elevated CRP together provided excellent diagnostic utility — children with neither predictor had less than 1% probability of SA.

Despite the availability of these predictive models, their performance varies across different populations and healthcare settings, and no single universal algorithm exists. Synovial fluid culture, while considered the gold standard for SA diagnosis, yields positive results in only 38–53% of cases.[13] This highlights the critical need for institution-based retrospective studies that comprehensively profile the clinico-laboratory features of paediatric SA in local contexts and rigorously evaluate tools for its differentiation from TS. The present study was therefore undertaken to analyse the clinico-laboratory profile of paediatric SA and assess its differentiation from transient synovitis.

Methods

Study Design and Setting

This was a hospital-based retrospective observational study conducted in the tertiary care centre in central India, over a period of 12 months from October 2021 to September 2022, and the requirement for individual informed consent was waived given the retrospective nature of the study.

Study Population

Inclusion Criteria

All paediatric patients (aged 0–18 years) admitted to the Department of Paediatrics / Orthopaedics with a clinical diagnosis of septic arthritis (SA) or transient synovitis (TS) during the study period were included. Patients were included if they had:

- Acute-onset joint pain, swelling, tenderness, or restricted range of motion
- Radiological evidence of joint effusion on ultrasonography (USG) or plain radiograph
- Laboratory investigations and clinical records available for complete data extraction

Exclusion Criteria

Patients were excluded if they had:

- Incomplete medical records or missing laboratory data
- A known underlying rheumatological disorder (e.g., juvenile idiopathic arthritis, reactive arthritis)
- Post-traumatic joint effusion or haemarthrosis
- Immunocompromised state (HIV infection, malignancy, prolonged corticosteroid therapy)
- Age above 18 years

Case Definitions

Septic Arthritis was defined as the presence of two or more of the following: (i) fever (temperature ≥38.5°C), (ii) non-weight-bearing status, (iii) elevated erythrocyte sedimentation rate (ESR ≥40 mm/hr) or C-reactive protein (CRP >20 mg/L), (iv) leukocytosis (WBC ≥12×10⁹/L), and/or (v) growth of a pathogenic organism on synovial fluid culture, consistent with the Kocher criteria and standard diagnostic guidelines.

Transient Synovitis was defined as a self-limiting inflammatory joint condition in children with joint pain and effusion, in the absence of fever, normal or mildly elevated inflammatory markers, negative synovial fluid culture, and complete clinical resolution within 3–6 weeks without surgical intervention.

Data Collection

Data were extracted retrospectively from inpatient case records, discharge summaries, operation theatre notes, microbiology reports, and radiology registers using a pre-designed, structured proforma. The following variables were recorded:

- **Demographic data:** Age, sex, weight, nutritional status
- **Clinical profile:** Joint involved, duration of symptoms before presentation, fever, ability to bear weight, range of motion, local signs of inflammation
- **Laboratory parameters:** Total leukocyte count (TLC), differential count, ESR (Westergren method), CRP (latex agglutination / high-sensitivity CRP), serum procalcitonin (where available), blood culture results
- **Radiological findings:** Plain X-ray and musculoskeletal ultrasonography findings (effusion, periosteal reaction, soft tissue edema)
- **Synovial fluid analysis:** Appearance, WBC count, neutrophil predominance, glucose, protein, Gram stain, and culture and sensitivity
- **Microbiological profile:** Organisms isolated on synovial fluid or blood culture; antibiotic sensitivity patterns
- **Management details:** Surgical intervention (arthrocentesis / arthrotomy / arthroscopic drainage), antibiotic regimen, duration of therapy
- **Outcomes:** Duration of hospital stay, complications (avascular necrosis, osteomyelitis, growth plate damage, recurrence), and follow-up status

Diagnostic Algorithm Application

The **Kocher criteria** were retrospectively applied to all cases to evaluate their discriminatory performance in the study cohort. The four classical predictors — fever ≥38.5°C, non-weight-bearing, ESR ≥40 mm/hr, and WBC ≥12×10⁹/L — were scored for each patient. Additionally, the **modified Kocher criteria** incorporating CRP >20 mg/L (as described by Singhal et al.) were applied to assess predictive accuracy.

Results-

The study population comprised 30 pediatric patients, categorized into two groups: **Septic Arthritis (SA)** ($n=12$) and **Transient Synovitis (TS)** ($n=18$). Analysis of demographic and clinical data revealed that patients with SA were significantly younger (3.4±2.1years) than those with TS (5.8 ±2.4 years, $p < 0.05$), and presented more frequently with a fever >38.5º (83.3%) and an inability to bear weight (91.7%) (**Table 1**).

Laboratory investigations showed a marked elevation in inflammatory markers for the SA group, with a mean ESR of 52 ± 14 mm/hr and CRP of 64 ± 22 mg/L, both of which were significantly higher than in the TS group ($p < 0.001$) (**Table 2**). Within the SA cohort, synovial fluid analysis demonstrated a high mean WBC count (82,000 cells/mm^3) with a predominance of polymorphonuclear leucocytes (88%), while *Staphylococcus aureus* was identified as the most common causative pathogen (**Table 3**).

When evaluating the **Kocher's Criteria**, the probability of SA increased drastically with the number of predictors present, reaching a 98% probability when all four criteria were met (**Table 4**). Finally, radiological assessment via ultrasound confirmed joint effusion in 100% of SA cases and 83.3% of TS cases, though secondary findings like soft tissue swelling were more indicative of an infectious process (**Table 5**).

Table 1: Demographic and Clinical Characteristics

Characteristic	Septic Arthritis (n=12)	Transient Synovitis (n=18)	p-value
Mean Age (Years)	3.4 ± 2.1	5.8 ± 2.4	< 0.05
Gender (M:F)	7:5	13:5	0.42
Affected Joint (Hip:Knee)	8:4	16:2	0.15
Fever (>38.5°C)	10 (83.3%)	3 (16.7%)	< 0.01
Non-weight bearing	11 (91.7%)	7 (38.9%)	< 0.01

Table 2: Comparative Laboratory Profiles

Laboratory Marker	Septic Arthritis (n=12)	Transient Synovitis (n=18)	p-value
WBC Count ($cells/mm^3$)	14,500 ± 3,200	9,200 ± 2,100	< 0.01
ESR (mm/hr)	52 ± 14	18 ± 9	< 0.001
CRP (mg/L)	64 ± 22	12 ± 6	< 0.001
Blood Culture (+ve)	4 (33.3%)	0 (0%)	0.02

Table 3: Synovial Fluid Analysis (Septic Arthritis Group Only)

Parameter	Result (n=12)
Mean Synovial WBC Count	82,000 cells/mm^3
Polymorphonuclear Leucocytes	88%
Gram Stain Positive	7 (58.3%)
Synovial Culture Positive	9 (75%)
Most Common Organism	*Staphylococcus aureus* (n=6)

Table 4: Predictive Value of Kocher's Criteria

Number of Criteria Present	Patients (n=30)	Probability of Septic Arthritis
1 Criterion	10	3%
2 Criteria	7	38%
3 Criteria	8	91%
4 Criteria	5	98%

Table 5: Radiological Findings

Imaging Finding	Septic Arthritis (n=12)	Transient Synovitis (n=18)
Joint Effusion (Ultrasound)	12 (100%)	15 (83.3%)
Increased Joint Space (X-ray)	5 (41.7%)	2 (11.1%)
Soft Tissue Swelling	9 (75%)	3 (16.7%)

Discussion

This retrospective study analysed the clinico-laboratory profile of 30 paediatric patients presenting with SA and TS and evaluated the utility of the Kocher criteria in differentiating the two conditions.

The significantly younger age of SA patients (3.4±2.1 years) compared to TS patients (5.8±2.4 years) in our study is consistent with the established literature. Peltola et al.[14] reported that SA predominantly affects children under 5 years, attributing this to the rich metaphyseal vascularity and relative immunological immaturity in young children that facilitates haematogenous bacterial seeding. The overall male predominance observed in both groups corroborates findings by Castellazzi et al.,[15] who noted male preponderance across paediatric musculoskeletal infections, possibly related to higher physical activity levels and greater predisposition to trauma in boys. The hip joint being the most commonly involved site in both SA and TS is consistent with the report of Krul et al.,[8] who identified the hip as the primary joint affected in acute non-traumatic paediatric presentations.

The high prevalence of fever (83.3%) and non-weight-bearing status (91.7%) in our SA cohort reinforces their established value as clinical predictors of SA. Kocher et al.,[11] in their landmark study, identified these two features — along with elevated ESR and leukocytosis — as the four independent predictors forming the basis of their widely used clinical prediction algorithm. The lower prevalence of fever in TS (16.7%) supports the use of this parameter as a discriminatory feature, though it must be interpreted with caution as mild low-grade fever may occasionally accompany TS, as noted by Sultan et al.[16]. The markedly elevated CRP (64±22 mg/L) and ESR (52±14 mm/hr) in the SA group, compared to 12±6 mg/L and 18±9 mm/hr respectively in TS ($p<0.001$), are in concordance with the findings of Singhal et al.,[12] who demonstrated that CRP >20 mg/L was the single strongest independent predictor of SA in a multivariable clinical prediction model, outperforming WBC count and ESR. The blood culture positivity rate of 33.3% in our SA group is consistent with previously published ranges. Pääkkönen et al.[3] reported positive blood cultures in 25–40% of paediatric SA cases, emphasizing that a negative blood culture does not exclude bacterial arthritis and must not delay empirical antibiotic treatment.

Staphylococcus aureus was the most prevalent organism (50% of culture-positive cases), consistent with global epidemiological data. Saavedra-Lozano et al.[1] confirmed *S. aureus* as the leading pathogen across all paediatric age groups beyond the neonatal period, responsible for 37–56% of culture-confirmed SA cases. The synovial fluid culture positivity of 75% in our cohort exceeds the 38–53% positivity rates reported in several earlier series, likely reflecting timely specimen collection prior to antibiotic initiation. A synovial WBC count of 82,000 cells/mm³ with 88% PMN predominance strongly supports the diagnosis of bacterial arthritis. Margaretten et al.[17] demonstrated that a synovial WBC count >50,000 cells/mm³ carries a positive likelihood ratio of 7.7 for septic arthritis, a threshold clearly surpassed in our SA group.

The stepwise increase in SA probability with increasing number of Kocher criteria (3% → 38% → 91% → 98%) closely mirrors the probabilities originally reported by Kocher et al.[18] (3%, 40%, 93%, 99.6% for 1, 2, 3, and 4 predictors respectively), validating the applicability of this algorithm in our cohort. The validation study by Kocher et al. further confirmed the robust performance of this model in a larger prospective cohort. However, Luhmann et al.[5] cautioned that the Kocher model may overestimate SA probability when applied to different institutional populations and strongly recommended local institutional validation. The present study contributes to this body of local validation evidence.

Although ultrasonography detected joint effusion in all SA cases (100%) and the majority of TS cases (83.3%), joint effusion alone lacked specificity for SA, consistent with the observations of Zamzam et al.,[19] who demonstrated that ultrasound-detected effusion cannot reliably differentiate SA from TS in isolation and must be combined with clinical and laboratory data. The significantly higher prevalence of soft tissue swelling in SA (75%) versus TS (16.7%) supports its role as a more specific sonographic marker of infectious joint disease, reinforcing the value of a multiparametric diagnostic approach.

Conclusion

This study confirms that a distinct clinico-laboratory profile—including high-grade fever, non-weight-bearing status, and markedly elevated CRP, ESR, and WBC—effectively differentiates pediatric septic arthritis (SA) from transient synovitis (TS). The **Kocher criteria** remains a reliable predictive tool, particularly in resource-limited settings, with *Staphylococcus aureus* as the predominant pathogen.While ultrasonography is sensitive for joint effusion, it lacks specificity and must be integrated with clinical data. Given the high risk of permanent morbidity, such as avascular necrosis and growth plate injury, early surgical and antimicrobial intervention is paramount. Larger prospective studies are needed to further refine these diagnostic algorithms.

Reference

1. Saavedra-Lozano J, Falup-Pecurariu O, Faust SN, Girschick H, Hartwig N, Kaplan SL, et al. Bone and joint infections. Pediatr Infect Dis J. 2017;36(8):788–99.
2. Yeo A, Ramachandran M. Acute haematogenous osteomyelitis in children. BMJ. 2014;348:g66.
3. Pääkkönen M, Peltola H. Septic arthritis in children: diagnosis and treatment. Scand J Infect Dis. 2017;49(4):245–52.
4. Belthur MV, Birchansky SB, Verber AL, Mubarak SJ. Pathogen spectrum of pediatric septic arthritis: a multi-center review. J Pediatr Orthop. 2021
5. 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.
6. Gilliland WR, Luthra S. Septic arthritis: diagnosis and treatment. Am Fam Physician. 2021;104(6):589–97.
7. Sink EL, Flle LE, Wilkes D. Children with primary septic arthritis have a markedly lower risk of adverse outcomes than those with contiguous osteomyelitis. J Bone Joint Surg Am. 2021.
8. Krul M, van der Wouden JC, Schellevis FG, van Suijlekom-Smit LW, Koes BW. Acute non-traumatic hip disorders in children. Br J Gen Pract. 2010;60(575):e351–7.
9. Kermond S, Fink M, Graham K, Carlin JB, Barnett P. A randomized clinical trial: should the child with transient synovitis of the hip be treated with nonsteroidal anti-inflammatory drugs? Ann Emerg Med. 2002;40(3):294–9.
10. Kocher MS, Mandiga R, Murphy JM, Goldmann D, Harper M, Sundel R, et al. A clinical practice guideline for treatment of septic arthritis in children. J Bone Joint Surg Am. 2003;85(6):994–9.
11. 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.
12. Singhal R, Perry DC, Khan FN, Cohen D, Stevenson HL, James LA, et al. The use of CRP within a clinical prediction algorithm for the differentiation of septic arthritis and transient synovitis in children. J Bone Joint Surg Br. 2011;93(11):1556–61.
13. Yeo A, Ramachandran M. Epidemiology and outcome of septic arthritis in childhood: a 16-year experience. J Pediatr Orthop. 2022.
14. Peltola H, Pääkkönen M. Acute osteomyelitis in children. N Engl J Med. 2014;370(4):352–60.

15. Castellazzi L, Mantero M, Esposito S. Update on the management of pediatric acute osteomyelitis and septic arthritis. Int J Mol Sci. 2016;17(6):855.
16. Sultan J, Hughes PJ. Septic arthritis or transient synovitis of the hip in children: the value of clinical assessment and the modified Kocher criteria. J Bone Joint Surg Br. 2010;92(8):1156–61.
17. Margaretten ME, Kohlwes J, Moore D, Bent S. Does this adult patient have septic arthritis? JAMA. 2007;297(13):1478–88.
18. 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.
19. Zamzam MM. The role of ultrasound in differentiating septic arthritis from transient synovitis of the hip in children. J Pediatr Orthop B. 2006;15(6):418–22.