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Applicability of Kocher's Criteria in Diagnosing Septic Arthritis of Weight-Bearing Joints in Children.

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Abstract— Background: Kocher's criteria have been used for a long time as a screening tool in diagnosing septic arthritis of the hip. The study aimed to assess the clinical presentation and applicability of Kocher's criteria for diagnosing septic arthritis of all weight-bearing joints. **Materials & Methods:** This retrospective cross-sectional analytical study of septic arthritisin children <12 years was done by collecting all the necessary data from electronic medical records from January 2018 to December 2022. **Results:** In a total of 28 cases of arthritis, the knee joint was the most affected, at 14 (50%), followed by the hip at 11 (39.5%) and the ankle at 3 (10.7%). Kocher's modified criteria were applied to all three weight-bearing joints. Three of the five criteria appeared to be strong predictors for septic arthritis: non-weight bearing was seen in 26 (92.9%), and 25 (89.3%) of the cases showed raised erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels. **Conclusions:** Kocher's criteria can be equally applied to all three major weight-bearing joints in diagnosing septic arthritis in contrast to only the hip joints, as mentioned in previous studies. Findings like the painful range of movements and an ultrasound investigation are important supplementary criteria for confirming the diagnosis.

Keywords: Septic Arthritis, Kocher's criteria, Weight-bearing, Erythrocyte Sedimentation Rate levels, C-reactive proteins levels.

1.Introduction:

Septic arthritis (SA) in children is not a clear diagnosis; if missed, it can have catastrophic repercussions, increasing the morbidity and mortality of the child.[1]Any delay in treating septic arthritis can spread to the underlying growth plate, destroying the physis and consequent loss of growth or tethering of the plate, deformity, and epiphyseal separation.[2]

The clinical presentation of arthritis and its outcome may vary depending on socioeconomic status, geography, and prevalent pathogens in those environments. By recognizing trends within specific population groups, an efficient protocol can be established to facilitate early case identification, early referral, prompt management, and reduce morbidity and mortality.[3]
Kocher et al.[4] Discovered four variables to discriminate between SA and tenosynovitis of the hip.
Kocher's criterion has shown different sensitivity depending on the research, populations, and sites. The C-reactive protein (CRP) levels were discovered to be a strong independent predictor in identifying septic arthritis and are an added important tool to the existing scoring system.[4–6]
Recent studies have shown that using LE strips can help detect various infections in body fluids. The LE strip was found to be easy, cheap, and fast, and it had promising results in the detection of infection in synovial fluid and aided in the early detection of septic arthritis.[7]
Despite being routinely applied, Kocher's criteria have limitations, and their projected probability differs in different studies, demographics, and centers. This is the reason most

clinicians rely on a mix of symptoms, physical examination, and lab evidence when suspected of septic arthritis. [8]

The study aims to evaluate the applicability of Kocher's criteria in diagnosing SA in all weight-bearing joints.

2.Methods:

2.1 Study Design:

This was a retrospective, cross-sectional analytical study.

2.2Study Population

Children <12 years of age diagnosed with septic arthritis (weight-bearing joints like the hip, knee, and ankle ofwere included in the study). Children over 12 years of age and children with septic arthritis of the wrist and shoulder were excluded from the study.

2.3 Ethical Consideration

Ethical approval from the Research and Ethical Review and Approval Committee (MH/DGHS/NBG: RERAC8/2022) was obtained.

2.4 Data Collection

In the medical record search, 28 cases were eligible for the study based on the inclusion criteria. The low number of cases is due to low incidence rate in this region The cases diagnosed with septic arthritis were selected for data collection. All eligible data available from the electronic medical records over 5 years between January 2018 and December 2022 from the Ministry of Health, a tertiary care hospital, that caters a population around seven to eight lakh in the North Batinah region was included in the study. The study was conducted from September 2022 to May 2023. Data on demography, detailed patient history, clinical examination, lab investigation, radiological investigations, treatment, and discharge summary were evaluated. A combined analysis and review of all the findings were done by the authors.

The potential selection bias was dealt with by the proper application of clear guidelines for selecting the cases along with meticulous and appropriate software utilization for data collection and analysis.

The four predictors of Kocher's criteria: (1) history of fever; (2) non-weight-bearing; (3) ESR > 40 mm/hr.; and (4) serum WBC count > 12,000 cells/μL; and additional findings like CRP levels, which were taken into consideration for the diagnosis of septic arthritis at the time of

DEMOGRAPHY		FREQUENCY(n=28)	PERCENT (100%)
AGE	2-5 yrs.	11	39.3
	6 -8 yrs.	7	25.0
	9-12 yrs.	10	35.7
SEX	F	11	39.3
	M	17	60.7
SITE	Ankle	3	10.7
	Hip	11	39.3
	Knee	14	50.0
SIDE	B/L	1	3.6
	LT	16	57.1
	RT	11	39.3

admission to the hospital, were recorded. The study identified and noted additional findings, such as joint pain, painful range of movements, and ultrasound findings, which supplemented Kocher's criteria at the time of diagnosis. The demographic distribution, like age, sex, site, and side, was analysed. Patients were arbitrarily divided into three age groups for convenience: 2-5 years old, 5-8 years old, and 9-12 years old. All the parameters obtained were represented as frequency and percentage.

2.5 Data Analysis

Septic arthritis cases were categorized based on the joint affected. The applicability of Kocher's criteria was evaluated. A Chi-square analysis was done to look for its applicability among the three weight-bearing joints. Microsoft Excel was used for data entry and management. Statistical analysis was done using SPSS software version 24.

3. Results:

A total of 28 patients were identified with septic arthritis. The ages of the children ranged from two years to twelve years old. The maximum number of children belonged to the 2–5-year age group, comprised of about 11 (39.3%). The number of male children was higher at 17 (60.7%) compared to 11 (39.3%) female children. The most cases of arthritis belonged to knees 14 (50%). Most of the cases were unilateral; 16 (57%) cases were left-sided, 11 (39.3%) right-sided, and 1 (3.6%) bilateral, as depicted in [Table 1].

Table 2: Distribution of cases according to joint involvement conclusive with modified Kocher's criteria.

KOCHER'S CRITERIA		HIP	KNEE	ANKLE	Total	*P - value*
Non-weight-bearing	Present	10(90.9%)	13(92.9%)	3(100%)	26(92.9%)	
	Absent	1(9.1%)	1 (7.1%)	0(0%)	2(7.1%)	.863
	Total	11(100%)	14(100%)	3(100%)	28(100%)	
Temperature > 38.5 degrees Celsius	Present	8(72.7%)	7(50.0%)	3(100%)	18(64.3%)	
	Absent	3(27.3%)	7(50.0%)	0(0%)	10(35.7%)	.197
	Total	11(100%)	14(100%)	3(100%)	28(100%)	
Serum ESR > 40 mm/hr.	< 40 and > 10	10(90.9%)	12(85.7%)	3(100.0%)	25(89.3%)	
	< 40 and > 20	0 (0.0%)	1(7.1%)	0 (0.0%)	1(3.6%)	.855
	>40	1 (9.1%)	1(7.1%)	0 (0.0%)	2(7.1%)	
	Total	11(100%)	14(100%)	3 (100%)	28(100%)	

WBC > 12,000 cells / mm3	Present Normal P/S: Increase neutrophils with toxic granulation. Total	5 (45.5%) 5 (45.5%) 1 (9.1%) 11(100%)	5 (35.7%) 8 (57.1%) 1 (7.1%) 14 (100%)	2 (66.7%) 1 (33.3%) 0 (0.0%) 3 (100%)	12(42.9% 14(50%) 2(7.1%) 28(100%)	.877
CRP	<20 - >10 1 <50->20 2 <100 ->50 3 >100 4 Total	0 (0.0%) 4 (36.4) 3 (27.3) 4 (36.4%) 11(100.0%)	3 (21.4%) 4 (28.6%) 7 (50.0%) 0 (0.0%) 14 (100%)	0 (0.0%) 2 (66.7%) 0 (0.0%) 1 (33.3%) 3 (100%)	3(10.7%) 10(35.7%) 10(35.7%) 5(17.9%) 28(100%)	.085

Out of 28 cases 26 (92.9%) cases were unable to bear the weight; 18 (64.3%) children presented with fever, and the rest of the 10 (35.7%) did not have a fever on admission. Almost all cases showed a raised ESR valve, and about 25 (89.3%) instances could satisfy Kocher's criteria for ESR. WBC > 12,000 cells / μL was seen only in 12 (42.9%). All the cases had elevated CRP levels, and in most cases, the CRP levels ranged from 20 to 100.

The predictors of Kocher's criteria for diagnosing septic arthritis have no significant difference across the three different weight-bearing joints The*P*-value is more than 0.05 for all the predictors across all three different joints as shown in Table 2.

Table 3: Additional findings conclusive of septic arthritis across weight-bearing joints.

Additional Findings		**Hip**	**Knee**	**Ankle**	***TOTAL***	***P -Value***
Pain	Present Absent Total	10((90.9%) 1 (9.1%) 11 (100%)	12(85.7%) 2 (14.3%) 14(100%)	2(66.7%) 1(33.3%) 3(100%)	24(85.7%) 4(14.3%) 28(100%)	.568
Painful Range of Movements	Present Absent	10((90.9%) 1 (9.1%)	11(78.6%) 3(21.4%)	2(66.7%) 1(33.3%)	23(82.1%) 5(17.9%)	.552

	Total	11 (100%)	14(100%)	3(100%)	28(100%)	
USG showing Joint effusion	Present	10((90.9%)	14(100%)	2(66.7%)	26(92.9%)	.120
	Absent	1 (9.1%)	0	1(33.3%)	2(7.1%)	
	Total	11 (100%)	14 (100%)	3(100%)	28(100%)	

Additional clinical findings, like joint pain and a painful range of movements, were also noted, which were seen in most children. Pain in the joints was present in 24 (85.7%) cases and a painful range of movements was found in 23 (82.1%) cases. Further, the radiological findings were also looked at, and it was noted that 26 (92.9%) cases showed the presence of joint effusion on ultrasonography

Additional findings for diagnosing septic arthritis have also shown no significant difference across the three different weight-bearingjoints. The*P*-value is more than 0.05 for all the predictors across all three different joints as shown in Table 3.

Discussion:

In our study, most of the cases were high suspects of septic arthritis and were mainly referred from peripheral hospitals. Kocher's criteria were applied to diagnose the cases of septic arthritis. The Caird's add-on criteria to the original Kocher's criteria, i.e., elevated C-reactive protein (which is also known as modified Kocher's criteria), was also used in all our cases to increase the accuracy of the diagnosis of septic arthritis. [4,6]

Among the four Kocher's criteria, non-weight bearing (92.9%) and an increase in ESR >40 mm/hr. (89.3%) were seen in most of the cases. Less than 40 ESR > 40 mm/hr. and more than 10 mm/hr. were seen in all the cases. This showed that ESR was a strong predictor for septic arthritis. Temperature > 38.5 degrees Celsius was observed in 64.3% of the cases, and WBC > 12,000 cells/µL was noticed in 42.9% of the cases. The reason could be that these children could have already been started on anti-inflammatory drugs during their initial visit to the peripheral hospitals. In this type of situation, Caird's add-on criteria, the fifth criteria, CRP level > 20 mg/L, was a strong independent risk factor for diagnosing children with septic arthritis. In our study, almost 89.3% of cases had a CRP level >20 mg/L, and in about 71.4% of cases, it ranged between 20 and 100 mg/L.

The study conducted by Hariharan P et al. [9] showed the sensitivity of ESR was 98% using a cutoff of ≥10 mm/h and 94% using a cutoff of ≥15 mm/h. The sensitivity of CRP was 92% using a cutoff of ≥20 mg/L. ESR and CRP levels are important Kocher's criteria for diagnosing septic arthritis.

A physical examination of the joint plays an important role in the initial assessment of septic arthritis. The most common symptom is joint pain, which was found in 85% of patients. A joint with a painful and limited active and passive range of motion is suggestive of an intra-articular infection. [10,11]

Pain in the joint and a painful range of movements were assessed for all cases included in our study. It was found that 90.9% of cases were positive for these findings. These two important additional clinical findings were valuable in diagnosing septic arthritis.

The supplementary radiological examination can be included in the protocol as supportive evidence in the diagnosis of septic arthritis. A basic radiological investigation, such as a plain X-ray, is less accurate when compared to an ultrasound examination in determining the intraarticular effusion. In our study, 92.9% of cases showed mild to moderate effusion on ultrasound of the affected joints. Therefore, an ultrasound of the joint can be included in the protocol for suspicious cases of arthritis, which can provide valuable input for confirming the diagnosis. [12]

Negative ultrasound reports need to be interpreted carefully. In our study, there was one case in which all five modified Kocher's criteria were present, but ultrasound showed no evidence of joint effusion. However, when the CT was done on this child, the diagnosis of acute osteomyelitis with ankle joint septic arthritis was made. Radiological investigations, such as CT or MRI scans, are extremely sensitive and specific in diagnosing septic arthritis associated with osteomyelitis. [13,14]

CT and MRI cost a lot more than ultrasound, and these procedures require sedation or anesthesia in small children. Therefore, CT and MRI are recommended only when there is a high suspicion of associated osteomyelitis along with septic arthritis.

Kocher et al.[4]and Caird et al.[6]identified predictive factors that aided in differentiating septic arthritis of the hip from transient synovitis. In our study, we found that all the predictive factors were equally applicable to all three weight-bearing joints; no significant difference was observed among the joints.

Kocher's Criteria is a well-known criterion being practiced by most practitioners across the globe for establishing the diagnosis of septic arthritis. Our study results coincide with this criterion for diagnosing septic arthritis, not only for the hip but for all three weight-bearing joints. Hence, our recommendation is to consider supplementary findings like painful range of movements and ultrasound findings as additional criteria for the diagnosis of septic arthritis of all the weight-bearing joints.

Further prospective studies at different tertiary care centers in the country need to be undertaken to endorse and broaden the study findings.

Limitation: The sample size is small because of the lower incidence of septic arthritis in children < 12 years in this region. Further research will be undertaken to cover other regionswithin and outside thecountry, to look for diagnostic utility in weight-bearing joints.

4. Conclusion:

In our study, non-weight-bearing, serum ESR > 40 mm/hr., and CRP > 20 mg/L were the strongest predictors of modified Kocher's criteria. Supplementary findings, such as joint pain, a painful range of movements, and an adjunct radiological ultrasound investigation, were valuable elements for confirming the diagnosis of septic arthritis in children younger than 12 years. Hence, painful range of movements and ultrasound findings can also be considered as additional criteria for the diagnosis of septic arthritis. The modified Kocher's criteria predictors were equally applicable to all three weight-bearing joints, in contrast to previous studies, which showed applicability mainly for the hip joint's septic arthritis.

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