

Orthopedics Case reports

Frequency of Microorganisms in Septic Arthritis in Children Under the Age of 10 Years

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Abstract

Background: Septic arthritis is an infrequent disease although very important due to the possibility of disastrous outcomes if treatment is not adequately established. Adequate information concerning the epidemiology of septic arthritis is still lacking.

Objective: To find determine the frequency of various microorganisms in septic arthritis in children under age of 10 year.

Materials and Methods: This Cross-Sectional Study was conducted in the Department of Orthopedics and Trauma, Medical Teaching Institute Lady Reading Hospital Peshawar Pakistan on from September 2022 to March 2023 on 171 consecutive patients. Non Probability Consecutive Sampling Technique was used in the study. Sample size was calculated using WHO sample size formula, using the proportion, anticipated frequency of *E. coli*, $p=8\%^3$, Margin of error=7.5%, Confidence Level=95%. Patient age 1 month to 10 years of both genders presenting with septic arthritis as per operational definition were included in the study while Patients with congenital joint deformity, Immunocompromised patients, Patients with rheumatologic joint disease and Patients with traumatic joint injury were excluded from the study. Septic arthritis was confirmed with clinical fever, pain and tenderness in the joint and ultrasound showing collection and debris in the joint cavity. Synovial fluid was aspirated for C/S. Pattern of microorganisms in the growth in the culture was noted.

Results: Mean age of the patients was 6.68 ± 1.239 years. Out of 177 patients, 96 (%) were male. Large joint arthritis was more common (63.8%). Staph aureus was the most common microorganism isolated in 79 patients (44.6%) while E coli was least commonly isolated (28 patients, 15.8%).

Conclusion: *S. aureus* is still the most common pathogen in acute joint infections in our environment in children under the age of 10 years.

Key words: Children; Infection; Microorganisms; Septic arthritis

Introduction

Septic arthritis is inflammation of the joints secondary to an infectious etiology such as bacterial, fungal, mycobacterial, viral, or other pathogens. It is usually monoarticular, however, polyarticular septic arthritis involving many or smaller joints may also occur [1]. Incidence varies from 2-10 per 100,000 patient years in the USA and Western Europe [2].

The clinical features of septic arthritis include fever, joint swelling redness, and tenderness with decreased range of both

active and passive movement [3]. Septic arthritis is a true orthopedic emergency. Delay in its diagnosis and treatment can lead to disastrous complications like destruction of articular cartilage, physical damage, and dislocation of joints. Despite significant improvement in medicine with availability of better antibiotics, septic arthritis is still a major cause of morbidity [4,5]. The cause is multifactorial as there is a shift in the microbiological spectra and epidemiology with emerging antibiotic resistance. This also has a distinct geographical variation [6].

Septic arthritis most commonly occurs in the hip and knee joints. Other joints commonly infected include the shoulder and ankle but it can occur in any synovial joint in the body. Staphylococcus aureus is the most common pathogen [7,8]. Other causative organisms include group A Streptococcus and Enterobacter species. Hemophilus influenza may also cause septic arthritis in children who have not been vaccinated. The incidence of Kingella kingae septic arthritis is almost certainly significant but underreported due to its fastidious nature in culture [4].

In a study by Moro-Lago and colleagues, in children with age less than 10 years presenting with septic arthritis, Staphylococcus aureus was most commonly isolated pathogen in 23% patients, followed by Streptococcus pneumoniae in 15%, Streptococcus pyogenes in 13% and *E. coli* in 8% patients [3].

Rationale: Septic arthritis is a debilitating orthopedic disorder that carries several immediate and long-term complications especially if treatment is delayed. There is still scarcity of knowledge regarding the spectrum of various pathogens isolated from the infected joint in our local population. The results of international studies cannot be generalized as there is considerable geographical variation in the pattern of pathogens. Therefore, we planned to determine the frequency of various microorganism in patients with septic arthritis. Results of this study will help in identification of burden of various microorganisms isolated from septic joints in our local population. It will also help researchers on this topic in future.

Materials and Methods

This Cross-Sectional Study was conducted in the Department of Orthopedics and Trauma, Medical Teaching Institute Lady Reading Hospital Peshawar Pakistan on from September 2022 to March 2023 on 171 consecutive patients. Non Probability Consecutive Sampling Technique was used in the study. Sample size was calculated using WHO sample size formula, using the proportion, anticipated frequency of *E. coli*, $p=8\%^3$, Margin of error=7.5%, Confidence Level=95%. Patient age 1 month to 10 years of both genders presenting with septic arthritis as per operational definition were included in the study while Patients with congenital joint deformity, Immunocompromised patients, Patients with rheumatologic joint disease and Patients with traumatic joint injury were excluded from the study.

After approval from hospital ethical board, patients fulfilling the inclusion criteria were enrolled from the indoor department of Orthopedic of the hospital a written informed consent was taken from all study participants after explaining the purpose of study. Demographic data including age (years), gender, duration of illness (days) and type of joint (large/small) and number of joint involved was noted.

Complete history was taken and physical examination was done including careful and gentle examination of the affected joint as per protocol. The involved joint was aspirated under sterile precautions in a separate procedure room under ultrasound guidance. Turbidity in the fluid was noted. 02cc aspirate was sent for gram stain and culture to the hospital laboratory within 30 minutes of taking the sample. Robertson Cooked Meat Media was used to transport the aspirated sample for culture.

The aspirate was cultured both in aerobic and anaerobic medium following standard protocols. Mac Conkey agar, blood agar, and chocolate agar was used for inoculation. The microorganisms was incubated for 48 hours. Growth Staph aureus, *E.*

coli, Strep pneumoniae and Strep pyogenes colonies was noted. Frequency of microorganism was noted as per operational definition. Data was recorded by the researcher himself on especially designed proforma. Data was entered and analyzed by using SPSS version 22.0.

Results

In this study, age of the patients ranged from 1 month to 10 years. Mean age was 6.68 ± 1.239 years, mean weight 12.07 ± 6.463 kg, mean height was 67.55 ± 7.883 cm, mean BMI was 20.865 ± 2.6605 kg/m² as shown in Table 1.

Frequency and % age of patients according to gender are shown in Table 2.

Frequency and % age of patients according to age are shown in Table 3.

Frequency and percentage of patients according type of joint are shown in Table 4 while Table 5 frequency and percentage according to number of joints involved.

Table 6 shows frequency and percentage according to disease duration.

The frequency and percentage of the patients according to microorganism is shown in Table 7.

Stratification of microorganisms with respect to age, gender, number of joint, type of joint and disease duration is shown in Table 8-12 respectively.

Table 1: Mean \pm SD of patients according to age, height, weight, BMI, N=177.

BASELINE DEMOGRAPHICS AND CHARACTERISTICS	MEAN \pm
	STD. DEVIATION
1. Patient Age (years)	6.68 \pm 1.239
2. Patient Height (cm)	67.55 \pm 7.883
3. Patient Weight (kg)	12.07 \pm 6.463
4. Patient BMI (kg/m ²)	20.865 \pm 2.6605

Table 2: Frequency and percentage of patients according to Gender, N=177.

PATIENT GENDER		
	Frequency	Percent
Male	96	54.2
Female	81	45.8
Total	177	100

Table 3: Frequency and percentage of patients according to age, N=177.

Age (years)		
	Frequency	Percent
<5	76	42.9
≥ 5	101	57.1
Total	177	100

Table 4: Frequency and percentage of patients according to disease duration, N=177.

DISEASE DURATION (days)		
	Frequency	Percent
5 days or below	93	52.5
More than 5 days	84	47.5
TOTAL	177	100

Table 5: Frequency and percentage of the patients according to type of joint involved, N=177.

TYPE OF JOINT		
	Frequency	Percent
LARGE	113	63.8
SMALL	64	36.2
Total	177	100

Table 6: Frequency and percentage of the patients according to number of joints involved, N=177.

NUMBER OF JOINTS AFFECTED		
	Frequency	Percent
SINGLE	107	60.4
MULTIPLE	70	39.6
Total	177	100

Table 7: Frequency and percentage of the patients according to microorganisms, N=177.

MICRO-ORGANISM ISOLATED		
	Frequency	Percent
Staph aureus	79	44.6
Strep pneumoniae	41	23.2
E. coli	28	15.8
Strep pyogenes	29	16.4
Total	177	100

Table 8: Stratification of microorganisms with respect to age, N=177.

AGE* MICROORGANISMS							
		MICROORGANISMS				Total	
		<i>Staph aureus</i>	<i>Strep penumo</i>	<i>E. coli</i>	<i>Strep pyo-genes</i>		
		32	15 (19.7%)	12	17	76 (100%)	p val- ue=0.286
	<5 years	-42.10%		-15.80%	-22.40%		
Age							
	≥5 years	47	26	16	12	101	
		-46.50%	-25.70%	-15.80%	-11.90%	-100%	
Total		79 (44.6%)	41 -23.20%	28 (15.8%)	29 (16.4%)	177 (100%)	

Table 9: Stratification of microorganisms with respect to gender, N=177.

GENDER * MICROORGANISMS								
		MICROORGANISMS				Total		
		<i>Staph aureus</i>	<i>Strep penumo</i>	<i>E. coli</i>	<i>Strep pyogenes</i>			
	Male	40	27(28.1%)	14	15	96(100%)	p value=0.427	
		-41.70%		-14.60%	-15.60%			
GENDER								
	Female	39	14	14	14	81		
		-48.10%	-17.30%	-17.30%	-17.30%	-100%		
Total		79(44.6%)	41	28(15.8%)	29 (16.4%)	177(100%)		
			-23.20%					

Table 10: Stratification of microorganisms with respect to disease duration, N=177.

DISEASE DURATION * MICROORGANISMS							
		MICROORGANISMS				Total	p value=0.764
		<i>Staph aureus</i>	<i>Strep penumo</i>	<i>E. coli</i>	<i>Strep pyogenes</i>		
DISEASE DURATION	≤5 days	41	23(24.7%)	16	13	93(100%)	
		-44.10%		-17.20%	-13.90%		
	>5 days	38	18	12	16	84	
		-45.20%	-21.40%	-14.30%	-19.00%	-100%	
Total		79(44.6%)	41 -23.20%	28(15.8%)	29(16.4%)	177(100%)	

Table 11: Stratification of microorganisms with respect to number of joints affected, N=177.

# OF JOINTS * MICROORGANISMS							
		MICROORGANISMS				Total	
		<i>Staph aureus</i>	<i>Strep penumo</i>	<i>E. coli</i>	<i>Strep pyogenes</i>		
# OF JOINTS	Single	52	25(22.1%)	17	19	113(100%)	p value=0.933
		-46.00%		-15.00%	-16.90%		
	Multiple	27	16	11	10	64	
		-42.20%	-25.00%	-17.20%	-15.60%	-100%	
Total		79(44.6%)	41 -23.20%	28(15.8%)	29(16.4%)	177(100%)	

Discussion

To our knowledge, this is the first of its kind study about occurrences and etiology of bacteria that cause septic arthritis and osteomyelitis in our local population. These data are likely to be an understanding of the etiology, antimicrobial pattern and occurrences of septic arthritis in our country.

Although septic arthritis is not a common disease, approximately 10 cases per year are identified at the studied hospital. Considering that these cases relate only to the knee joint, it can be said that this disease has a significant importance in our environment, in terms of incidence in relation to other joints and other regions of the world [9]. The presence of patients classified as Newman type C may have caused selection bias in this study, as the evaluation of purulent secretion is arbitrary, and can sometimes be mistaken for inflammatory fluid of rheumatological diseases.

Considering the samples studied, the mean age demonstrates that septic arthritis is a disease with great predominance among children (patients were younger than 10 years of age) and has gained significant representation among children between 6 to 10 years of age. Although most patients with this condition have not presented unfavorable outcomes, infection among elderly patients may result in more serious consequences [10].

The great majority of the infections were of hematogenous origin. However, cases in which there was an infection in the

Table 12: Stratification of microorganisms with respect to type of joint, N=177.

TYPE OF JOINT * MICROORGANISMS						
		MICROORGANISMS				Total
		<i>Staph aureus</i>	<i>Strep penumo</i>	<i>E. coli</i>	<i>Strep pyogenes</i>	
TYPE OF JOINTS	Small	50(46.7%)	30(28.0%)	11(10.3%)	16 (15.0%)	107(100%)
	Large	29(41.4%)	11 (15.7%)	17 (24.3%)	13 (18.6%)	70(100%)
Total		79(44.6%)	41 (23.2%)	28(15.8%)	29(16.4%)	177(100%)

p value=0.034

contiguity of the joint and cases in which needles were introduced in the knee were responsible for a small portion of the infections (6.5% and 3.2%, respectively). This reinforces the notion that joint infiltrations should be carried out in appropriate environments with rigorous aseptic techniques and that infectious processes around joints should be considered severe because of the intra articular complications they can cause [11]. Another risk factor for joint infections is the use of illicit intravenous drugs, because this practice provides a distant entry point that can favor hematogenic dissemination [12].

The rate of joint disease in septic arthritis patients was similar to that found in the literature, as well as greater presence of osteoarthritis among these pathological conditions [13]. Unlike elderly patients where most of the patients present with some clinical comorbidities, among which SAH and DM were the most common, co-morbidities were not as prevalent in children as in adults [13]. Greater number of comorbidities was associated with poor prognosis of the disease. A few patients had hematological disorder like hemophilia and thalassemia. There were small number of patients with immunosuppression, especially related to neoplasias and chronic use of corticosteroids. This can be explained by the fact that this hospital complex is a reference center for treatment of neoplastic and rheumatological diseases, thus concentrating a greater number of patients with these diseases or comorbidities [14].

Similar to cases of other infections of the musculoskeletal system, systemic symptoms such as fever were of little help for the diagnosis, since less than 50% of the patients presented with high temperature initially. Furthermore, the leukocyte count must not be used to rule out joint infection, because leukocytosis was present in only approximately 50% of the cases. Unlike the elevated leukocyte counts, inflammatory tests (ESR and CRP) were positive in 100% of the cases. Results of these tests within the normal range are not indicative of the diagnosis of septic arthritis [15, 16].

The present study did not show any increase in the number of surgical procedures, or any development of systemic or joint complications through delayed indication of surgical treatment. Only one of the patients who presented more than 10 days of complaints underwent more than one surgical drainage procedure, although there is support in the literature for the belief that a delay of more than three days after the beginning of the symptoms can lead to a worse prognosis [17].

The great majority of the cultures showed growth of Gram-positive bacteria, especially *S. aureus* (44.6%), which is consistent with the epidemiology found in several regions of the world. This also corroborate the findings from a previous service in the 1990s, when *S. aureus* was found in 68.8% of the cases [12]. Only 31 initial synovial fluid sampling were positive for Gram-stained bacteria, showing that such result cannot be

taken as definitive for guiding whether to drain the joint, in cases of suspected septic arthritis.

In our service, out of the 28 cases (45.9%) that have not presented positive Gram staining, only six had not undergone drainage initially and had to wait for the definitive culture, for diagnosis confirmation. The diagnostic approach needs to be based not only on Gram staining but also on the systemic and local clinical condition, on inflammatory tests such as CRP and ESR, and on the differential cell count in the synovial fluid.

High incidence of oxacillin-resistant *S. aureus* was observed, which prompted the initial empirical antibiotic regimen to be changed for 18% of the patients [18].

Conclusion

It is important to characterize each population epidemiologically, so that empirical treatment based on local evidence can be implemented. From the data analysis, it was possible to conclude that *S. aureus* is still the most common pathogen in acute knee infections in our environment. Risk factors such as comorbidities, immunosuppression and degenerative and inflammatory diseases also constitute important associated factors. Gram staining, absence of fever and normal leukocyte count cannot be used to rule out septic arthritis.

References

1. Dendrinis GK, Kontos S, Katsenis D, Dalas A. Treatment of high-energy tibial plateau fractures by the Ilizarov circular fixator. *J Bone Joint Surg Br.* 1996; 78: 710-717.
2. Gaudinez RF, Mallik AR, Szporn M. Hybrid external fixation of comminuted tibial plateau fractures. *Clin Orthop Relat Res.* 1996; 328: 203-210.
3. Marsh JL, Smith ST, Do TT. External fixation and limited internal fixation for complex fractures of the tibial plateau. *J Bone Joint Surg Am.* 1995; 77: 661-673.
4. Ries MD, Meinhard BP. Medial external fixation with lateral plate internal fixation in metaphyseal tibia fractures. A report of eight cases associated with severe soft-tissue injury. *Clin Orthop Relat Res.* 1990; 256: 215-223.
5. Stamer DT, Schenk R, Staggers B, Aurori K, Aurori B, et al. Bicondylar tibial plateau fractures treated with a hybrid ring external fixator: A preliminary study. *J Orthop Trauma.* 1994; 8: 455-461.
6. Waddell JP, Johnston DW, Neidre A. Fractures of the tibial plateau: A review of ninety-five patients and comparison of treatment methods. *J Trauma.* 1981; 21: 376-381.
7. Watson JT. High-energy fractures of the tibial plateau. *Orthop Clin North Am.* 1994; 25: 723-752.
8. Weiner LS, Kelley M, Yang E, Steuer J, Watnick N, et al. The use of combination internal fixation and hybrid external fixation in

- severe proximal tibia fractures. *J Orthop Trauma*. 1995; 9: 244-250.
9. Mallik AR, Covall DJ, Whitelaw GP. Internal versus external fixation of bicondylar tibial plateau fractures. *Orthop Rev*. 1992; 21: 1433-1436.
10. Volpin G, Dowd GS, Stein H, Bentley G. Degenerative arthritis after intraarticular fractures of the knee, long term results. *J Bone Joint Surg Br*. 1990; 72: 634-638.
11. Buckwalter JA, Brown TD. Joint injury, repair, and remodeling: roles in posttraumatic osteoarthritis. *Clin Orthop*. 2004; 423: 7-16.
12. Dirschl DR, Dawson PA. Injury severity assessment in tibial plateau fractures. *Clin Orthop Relat Res*. 2004; 423: 85-92.
13. Barei DP, Nork SE, Mills WJ, Coles CP, Henley MB, et al. Functional outcomes of severe bicondylar tibial plateau fractures treated with dual incisions and medial and lateral plates. *J Bone Joint Surg Am*. 2006; 88: 1713-1721.
14. Dirschl DR, Dawson PA. Injury severity assessment in tibial plateau fractures. *Clin Orthop Relat Res*. 2004; 423: 85-92.
15. Schatzker J, McBroom R, Bruce D. The tibial plateau fracture. The toronto experience 1968-1975. *Clin Orthop Relat Res*. 1979; 138: 94-104.
16. Caspari RB, Hutton PM, Whipple TL, Meyers JF. The role of arthroscopy in the management of tibial plateau fractures. *Arthroscopy*. 1985; 1: 76-82.
17. Holzach P, Matter P, Minter J. Arthroscopically assisted treatment of lateral tibial plateau fractures in skiers: Use of a cannulated reduction system. *J Orthop Trauma*. 1994; 8: 273-281.
18. Dias JJ, Stirling AJ, Finlay DB, Gregg PJ. Computerised axial tomography for tibial plateau fractures. *J Bone Joint Surg Br*. 1987; 69: 84-88.