Original article

Clinical Spectrum and Treatment Outcomes of Osteoarticular Infections in Children at a Tertiary Care Hospital, Karachi

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ABSTRACT

Background: Osteoarticular infections (OAI) in children, including septic arthritis (SA) and osteomyelitis (OM), cause significant morbidity and are commonly due to *Staphylococcus aureus*, including MRSA. Delayed diagnosis and antimicrobial resistance worsen outcomes. This study describes the clinical features, microbial profile, and outcomes of pediatric OAI at a tertiary care center in Karachi to guide local management.

Patients and methods: This cross-sectional study was conducted at the Pediatric Infectious Disease Department, NICH Karachi, from June to December 2023. Children under 16 years with confirmed osteoarticular infections (OM or SA) were included. The diagnosis of osteomyelitis was based on clinical signs (pain, swelling, restricted movement), fever >37.5°C, leukocytosis (>13,000/µL), elevated ESR (>20 mm/hr), and supportive radiological or microbiological evidence. Data on clinical features, infection site, lab markers, diagnostics, interventions, culture results, and outcomes were collected using a structured proforma. Common complications included swelling, pain, fever, joint stiffness, infection recurrence, and the need for surgery. Patients with complications required surgery, antibiotics, physical therapy, follow-up, and repeat imaging. Data were analyzed in SPSS v26 using descriptive statistics, the Shapiro-Wilk test, and binary logistic regression, with p≤0.05 considered statistically significant.

Results: Total 144 patients were enrolled with median age of 8 (IQR=2-12) years. Majority were males (62.5%). One third patents 44 (33.3%) were diagnosed with osteomyelitis Length of hospital days was 4 (IQR=3-7) days. 55.6% patients were completely treated, 3.5% expired, 1.4% developed complications and 39.6% needed further intervention. The final outcome was good among 55.6% and poor among 44.4%. None of the patient's feature was found to be significantly associated with final outcome except those who had warmth and limited range on presentation.

Conclusion: Septic arthritis was more common. There was higher burden of poor outcomes. Patients should be continuously under strict surveillance with evaluation of all possible laboratory biomarkers to early prediction and improvement of treatment outcomes.

Keywords:

Osteoarticular infection, Osteomyelitis, Septic rthritis, Infection, Pediatrics

INTRODUCTION

Osteoarticular infections (OAI) clinically exhibit as osteomyelitis (OM), septic arthritis (SA), or combination of both.[1]. OM is characterized by bone inflammation resulting from microbial infection which may lead to bone destruction.[2] These infections may advance to irremediable bone and muscle injury, joint damage or even sepsis.[3] Globally, estimated 0.1-0.3% of pediatric populaces are affected by OAI and with estimated financial burden of $17,000 to $150,000 per patient.[4] Yearly, nearly 7.3 million children expire internationally.[5] OM incidence in developed countries varies between 1-13 per 1,00,000 populace.[2,3,6,7] Higher prevalence reports of up to 200 per 1,00,000 stated for emerging nations.[8] Most cases of acute pediatrics OM are hematogenous infections with 8 cases per 100,000 children yearly incidence.[7,9] OAI can occur at any age but two distinct groups have a greater susceptibility; infants and children less than five years of age. Septic arthritis (SA) has an estimated incidence of 4 cases per 100,000 children per year, occurring more frequently in males under 5 years of age.[10] In the case of osteomyelitis (OM), an incidence of 2–13 cases per 100,000 children is estimated.[11] Early diagnosis and appropriate treatment are important to achieve optimal goals and to reduce complications, decrease treatment duration and optimizing outcomes.[7,12] The clinical characteristics, X-ray findings, and laboratory results should be considered in conjunction for the diagnosis. In general, bone cultures, subperiosteal

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exudate, and joint fluid provide microbiological diagnosis in 30% to 80% of cases.[13] In children, clinical spectrum of OAI differs based on age, bone and microorganism involved. Typically, children show up within 2 weeks after discomfort onset and exhibition of inflammation sign at the affected limb.[14] Commonly affected joints are elbows, shoulders, hips and knees but about 20% of patients have problems in multiple joints. Localized pain, agitation, fever, and functional constraint are the primary symptoms.[15] Fever is typically not a clinical indicator of neonatal illness.[8] Important clinical findings include the refusal to feed and to bear weight on the afflicted extremity, particularly in very young children.[16] Occasionally, nevertheless, standard clinical signs are absent. To get a conclusive diagnosis, it is crucial to adhere to a particular clinical, laboratory, and imaging work-up.[15,16] Children with acute OAI were treated with varying durations of IV therapy and antibiotic medication for at least six weeks. If necessary, antibiotics should be changed after a pathogen is identified.[16] Surgery has been reported to be able to clean the surrounding soft tissue, remove the demineralized bone, and change the course of bone necrosis in OM patients, all of which reduce the bacterial load.[17] Inadequate treatment for osteochondral joint disruption (OAI) can result in severe consequences such axial deviation or leg disparity, growth disturbance, toxic shock, or even death. OAI can cause deep vein thrombosis, pyomyositis, necrotizing fasciitis, sequestrum formation, intramedullary, subperiosteal, or subcutaneous abscesses.[7,10,17] Although there has been a decrease in the prevalence of these diseases since the late 1970s, they remain one of the main causes of hospital admissions, disability, and chronic, severe pain in developing nations.[18] However, the related literature among Pakistan is scare. This study aims to determine clinical spectrum and treatment outcomes of OAI in children at National Institute of Child Health Karachi, Pakistan.

PATIENTS AND METHODS

This cross-sectional study was performed in Pediatric Infectious Department at National Institute of Child Health Karachi, Pakistan from 1st June till 31st December 2023. Ethical approval from institutional review board was obtained (IERB-25/2023). All admitted children under the age of 16 years and of either gender with confirmed diagnosis of OAI (OM or SA) were enrolled. Written informed consent of parents was obtained. Sample size of 144 children was estimated taking 30% proportion of OAI, 95% confidence interval and 7.5% margin of error. Online calculator Open-Epi was used to estimate sample size.[19] OM was characterized by the existence of clinical symptoms (such as pain, tenderness, redness, swelling and restriction of movement) and coupled with any of the following: fever exceeding 37.5°C, leukocytosis with white cell counts exceeding 13,000/µL, elevated erythrocyte sedimentation rate surpassing 20 mm or a positive blood culture. SA was characterized by all clinical features and laboratory investigations similar to OM but primarily localized to the joints.[20,21] Diagnosis was confirmed using cultures from blood, bone, or joint aspirates to identify the causative organism. Imaging modalities such as ultrasound or MRI were utilized to evaluate soft tissue involvement, detect abscesses, and assess joint effusion. A combination of clinical, radiological, and microbiological findings established the final diagnosis. Data collected included age, gender, site of osteomyelitis/septic arthritis, presenting symptoms, inflammatory markers (CRP levels, TLC), platelet count and hemoglobin on admission, diagnostic method, surgery, complications, outcome alive or dead. Common complications observed in patients with osteomyelitis included swelling, warmth, pain, erythema, limited range of motion, fever, joint stiffness, site-specific limb involvement, infection recurrence, and the need for surgery. The final outcomes were categorized as Good outcome was defined as those were alive discharges without any complication otherwise outcome was considered poor. The patients who developed complication need further interventions like surgical treatments (e.g., drainage, debridement), extended antibiotic therapy, physical therapy for joint stiffness, and regular follow-up to monitor infections. Repeat imaging and cultures were conducted to track progress and identify new infections. Data was entered in SPSS version 26 for statistical analysis. Categorical variables were expressed as frequency or percentage. Non-normal data was expressed as median with inter-quartile ranges after assessing normality assumption with Shapiro-Wilk test. Binary logistic regression was applied to determine association of patients' features with final outcome. A p-value ≤0.05 was taken as statistically significant.

RESULT

Total 144 patients were enrolled with median age of 8 (IQR=2-12) years. Majority were males (62.5%). One third patents were diagnosed with osteomyelitis. Length of hospital days was 4 (IQR=3-7) days. Table 1 summarizes patients' demographic and clinical characteristics.

Among the 144 pediatric patients with osteomyelitis or septic arthritis, no significant association was found between age or gender and final outcomes, though females tended to have better outcomes than males. Osteomyelitis cases showed a trend toward more favorable outcomes compared to septic arthritis, but the difference was not statistically significant. Bone site involvement was a key factor: epiphyseal involvement

Table 1: Overview of patients' demographic and clinical characteristics

Characteristics	Total, n (%)	Diagnosis		p-value
		Osteomyelitis, n (%)	Septic arthritis, n (%)	
Age				
<2 years	32 (22.2)	6 (12.5)	26 (27.1)	*0.014
2-4 years	13 (9)	4 (8.3)	9 (9.4)	
5-9 years	42 (29.2)	22 (45.8)	20 (20.8)	
≥10 years	57 (39.6)	16 (33.3)	41 (42.7)	
Gender				
Male	90 (62.5)	30 (50)	60 (66.7)	1.000
Female	54 (37.5)	18 (50)	36 (66.7)	
Site				
Lower limb	129 (89.6)	42 (48.3)	87 (67.4)	┼0.729
Upper limb	11 (7.6)	4 (57.1)	7 (63.6)	
Other	4 (2.8)	2 (100)	2 (50)	
Laterality				
Right	79 (54.9)	32 (68.1)	47 (59.5)	┼0.095
Left	63 (43.8)	16 (34)	47 (74.6)	
Bilateral	2 (1.4)	0 (0)	2 (100)	
Bone involvement				
Femur	65 (45.1)	18 (38.3)	47 (72.3)	┼*0.001
Carpal	4 (2.8)	4 (8.3)	0 (0)	
Humerus	3 (2.1)	0 (0)	3 (100)	
Metatarsus	4 (2.8)	4 (8.3)	0 (0)	
Patella	3 (2.1)	0 (0)	3 (3.1)	
Pelvis	27 (18.8)	6 (28.6)	21 (77.8)	
Radius	3 (2.1)	0 (0)	3 (100)	
Ribs	2 (1.4)	2	0	
Tarus	7 (4.9)	4 (133.3)	3 (42.9)	
Tibia	24 (16.7)	10 (71.4)	14 (58.3)	
Vertebrae	2 (1.4)	0	2	
Site of bone				
Diaphysis	14 (9.7)	8 (133.3)	6 (42.9)	0.006
Epiphysis	57 (39.6)	10 (21.3)	47 (82.5)	
Metaphysis	26 (18.1)	12 (85.7)	14 (53.8)	
None	47 (32.6)	18 (62.1)	29 (61.7)	
Swelling				
Yes	70 (48.6)	20 (40)	50 (71.4)	0.238
No	74 (51.4)	28 (60.9)	46 (62.2)	
Warmth				
Yes	16 (11.1)	4 (33.3)	12 (75)	0.453
No	128 (88.9)	44 (52.4)	84 (65.6)	
Pain				
Yes	87 (60.4)	36 (70.6)	51 (58.6)	*0.011
No	57 (39.6)	12 (26.7)	45 (78.9)	
Erythema				
Yes	5 (3.5)	2 (66.7)	3 (60)	┼1.000
No	139 (96.5)	46 (49.5)	93 (66.9)	
Limited range				
Yes	45 (31.3)	14 (45.2)	31 (68.9)	0.703
No	99 (68.8)	34 (52.3)	65 (65.7)	
Fever				
Yes	64 (44.4)	22 (52.4)	42 (65.6)	0.813
No	80 (55.6)	26 (48.1)	54 (67.5)	
X-ray				
Positive	102 (70.8)	40 (64.5)	62 (60.8)	0.053
Negative	26 (18.1)	4 (18.2)	22 (84.6)	
Not done	16 (11.1)	4 (33.3)	12 (75)	
Ultrasonography				
Positive	36 (25)	6 (20)	30 (83.3)	*0.034
Negative	12 (8.3)	6 (100)	6 (50)	
Not done	96 (66.7)	36 (60)	60 (62.5)	
MRI				
Positive	113 (78.5)	40 (54.8)	73 (64.6)	┼0.676
Negative	1 (0.7)	0 (0)	1 (100)	
Not done	30 (20.8)	8 (36.4)	22 (73.3)	
Surgery				
Yes	88 (61.1)	26 (41.9)	62 (70.5)	0.227
No	56 (38.9)	22 (64.7)	34 (60.7)	

┼: Fisher-exact test is reported, *Significant at 5% significance level

Table 2: Association of demographic, clinical, and laboratory characteristics with final treatment outcomes in pediatric patients with osteomyelitis and septic arthritis

Groups	Final outcome		OR (95% CI)	p-value
	Good, n (%)	Poor, n (%)		
Demographic Characteristics				
Age				
<2 years	16 (20)	16 (25)	1.04 (0.44-2.46)	0.937
2-4 years	8 (10)	5 (7.8)	0.65 (0.18-2.22)	0.489
5-9 years	27 (33.8)	15 (23.4)	0.58 (0.25-1.30)	0.185
≥10 years	29 (36.3)	28 (43.8)	Reference category	
Gender				
Male	46 (51.1)	44 (48.9)	1.62 (0.82-3.24)	0.167
Female	34 (63)	20 (37)	Reference category	
Association of Common complications and Investigations for OM and SA with outcomes				
Diagnosis				
Osteomyelitis	30 (62.5)	18 (37.5)	0.65 (0.32-1.32)	0.237
Septic arthritis	50 (52.1)	46 (47.9)	Reference category	
Site				
Lower limb	72 (55.8)	57 (44.2)	0.79 (0.11-5.79)	0.818
Upper limb	6 (54.5)	5 (45.5)	0.83 (0.08-8.24)	0.876
Other	2 (50)	2 (50)	Reference category	
Site of bone				
Diaphysis	9 (64.3)	5 (35.7)	0.45 (0.13-1.54)	0.204
Epiphysis	38 (66.7)	19 (33.3)	0.40 (0.18-0.89)	*0.026
Metaphysis	12 (46.2)	14 (53.8)	0.94 (0.36-2.46)	0.904
None	21 (44.7)	26 (55.3)	Reference category	
Swelling				
Yes	38 (54.3)	32 (45.7)	1.11 (0.57-2.13)	0.766
No	42 (56.8)	32 (43.2)	Reference category	
Warmth				
Yes	4 (25)	12 (75)	4.38 (1.34-14.34)	*0.015
No	76 (59.4)	52 (40.6)	Reference category	
Pain				
Yes	45 (51.7)	42 (48.3)	1.48 (0.75-2.92)	0.254
No	35 (61.4)	22 (38.6)	Reference category	
Erythema				
Yes	2 (40)	3 (60)	1.91 (0.31-11.84)	0.483
No	78 (56.1)	61 (43.9)	Reference category	
Limited range				
Yes	32 (71.1)	13 (28.9)	0.38 (0.18-0.81)	*0.013
No	48 (48.5)	51 (51.5)	Reference category	
Fever				
Yes	36 (56.3)	28 (43.8)	0.95 (0.49-1.84)	0.881
No	44 (55)	36 (45)	Reference category	
Surgery				
Yes	49 (55.7)	39 (44.3)	0.98 (0.50-1.93)	0.970
No	31 (55.4)	25 (44.6)	Reference category	
Association of Clinical and Laboratory Investigations for OM and SA with outcome				
Hemoglobin#	11 (10-12.5)	10.9 (9.9-12.2)		
TLC#	10.3 (7.8-14.7)	9.7 (7.8-14.1)	0.99 (0.98-1.06)	0.986
Platelets#	392 (288-517)	367 (217-498.5)	0.99 (0.99-1.01)	0.353
CRP#	21.9 (6.3-94.6)	16.8 (5.9-50.9)	0.99 (0.99-1.01)	0.259
Outcomes and predictive factors for OM and SA				
	Frequency	**Percentage**		
Completely treated	80	55.6		
Expired	5	3.5		
Developed complications	2	1.4		
Needed further intervention	57	39.6		

#: Data is presented median with inter-quartile ranges, CI: Confidence interval, OR: Odds ratio, *Significant at 5% significance level

was significantly associated with better outcomes, while other sites showed no clear impact. The presence of joint warmth was significantly linked to poorer outcomes, suggesting more severe disease. In contrast, limited range of motion was associated with better recovery. Other clinical features, including swelling, pain, erythema, and fever, showed no significant association. Surgical intervention and laboratory markers (hemoglobin, TLC, platelets, CRP) were not predictive of outcome. Overall, 55.6% of patients were completely treated, while 39.6% required further intervention, and a small number either expired or developed complications (Table 2).

DISCUSSION

This study evaluated clinical spectrum and management of osteoarticular infections management. One-third of patients (33.3%) presented with osteomyelitis whereas the remaining had septic arthritis (66.7%). The distribution of osteomyelitis and septic arthritis varies in literature. One study evaluating long-term outcomes of osteoarticular infections reported that 39% patients had osteomyelitis, 34% had septic arthritis, and 27% were combined cases of osteomyelitis and septic arthritis.[22] Another study reported that 50% had SA, 35% had OM, and 15% had both.[15] Monsalve and coworkers found that 41.8% patients had isolated OM without SA, 39.5% had SA with OM and 18.6% had isolated SA.[16] Another larger study from South Korea analyzing 21,552 patients reported that 7422 patients were diagnosed with OM and SA was diagnosed in 14,100 patients.[13] Hematogenous spread of bacteria is commonest cause of OM and SA. Thus, the differences in distribution of OM and SA could occur because of differences in local pathogens prevailing the most in environment. The clinical presentation and progression of OM are influenced by various factors and one of them is patients' age. In our study, 8 years was median of patients' age. It was seen that SA was more common in all age groups except for 5-9 years. Moreover, the greater frequency of septic arthritis was seen for children under 2 years of age. One previous study also highlighted that higher likelihood of SA was seen for children under 2 years of age.[16] This higher frequency of septic arthritis among children below 2 years of age is also reported in another study from Ethiopia.[23] SA may occur as a result of penetrating injuries affecting knee joint in this age group during crawling.[16,23] Among infants, there is likelihood of direct extension of a metaphyseal abscess through the growth plate via vascular channels into the epiphysis and further in the joint space. Prior to reaching age 18 months of age, small vessels intersect the proximal growth plate of the femur from metaphysis to epiphysis.[24] As a consequence, this age group has a likelihood of metaphyseal abscess that can readily extend directly into the joint. However, afterwards 18 months, the vascular channels diminish and then growth plate acts as a barrier to the terminal vessels of the metaphysis.[25] The overall outcome was poor in 44.4%. The study findings are consistent with other similar studies reporting 45% and 47% burden of poor treatment outcomes in OAI patients.[5,26,27] However, some of the studies reported a lower burden of poor outcomes ranging from 11.1%-31%.[27,28] As compared to this study findings, a prevalence of poor outcomes ranging between 55-57% is also documented in existing studies.[29,30,] This variation in outcomes could stem from geographical disparities, difference in follow-up period, divergence in management modality and method of outcome evaluation. This study analyzed that the likelihood of poor outcomes was higher in under 2 years of age, but it did not achieve statistical significance. The finding is consistent with earlier studies that did not find correlation of age and sequelae.[31.32] However, there are some studies which established association of age with poor outcomes and found that patients below one month and up to 3 years group were likely to experience adverse outcomes.[3,33] A probable rationalization for our results is that school going children with OAI were more accurately describing their physical condition than younger children. In this study, overall, 61.1% underwent surgical procedure while 54.2% of OA patients and 64.6% of SA patients required surgical management. In a previous study, it was analyzed that 74.1%of the patients required surgical intervention.[34] Likewise, one more study reported that 80% of patients experienced at least one surgical procedure, with surgical cleaning the most common intervention.[24] In one study, 78% of total sample were surgically managed.[23] In this study, the relationship between surgical management with treatment outcomes was not observed. Hanffs and coworkers did not find statistical substantial link between surgical management and treatment outcomes.[35] However, one study reported that surgical interventions reduced the complication risks and adverse treatment outcomes by about 70%.[23] The surgical treatment of OAI remains a challenge. Despite of multiple publications on the subject, still debate is ongoing between those endorsing surgical management and those seeing surgery as aggressive. Regrettably, the emphasis of debate is on whether proceeding with surgery rather than detecting pathogens causing OAI.

CONCLUSION

Septic arthritis was more common with higher burden of poor outcomes. Patients should be continuously under strict surveillance with evaluation of all possible laboratory biomarkers to early prediction and improvement of treatment outcomes.

Author Contributions

MA: Conception and design, analysis and interpretation of data, drafting the article, critical revision for important intellectual content, final approval.
WH: Conception and design, analysis and interpretation of data.
BUN: Analysis and interpretation of data, drafting the article.
SW: Acquisition of data, conception and design, analysis and interpretation.
KP: Analysis and interpretation of data, proofreading.
HW: Conception and design, analysis and interpretation of data.

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