Original Article

Childhood Pyogenic Osteomyelitis in Abakaliki, South East Nigeria

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Abstract

Background: Pyogenic osteomyelitis is an important child health problem in developing countries. It is a one-disease state with a spectrum of pathological features and clinical forms ranging from acute to chronic presentation. Its pattern of presentation varies from and within subregions. The aim of this study was to determine the pattern and outcome of childhood pyogenic osteomyelitis in a low-resource environment. **Materials and Methods:** This was a retrospective study of all the children aged 18 years and under seen with pyogenic osteomyelitis in Federal Teaching Hospital Abakaliki between January 2005 and December 2015. **Results:** In 76 patients, there was pyogenic osteomyelitis involving 85 bones. Female-to-male ratio was 1:1.7, and the mean age was 9.9 ± 5.1 years. The clinical forms of presentation were acute in 16 (21.1%), subacute in 10 (13.2%), and chronic in 50 (65.8%) patients. Acute osteomyelitis was the more likely form of presentation among infants ($P < 0.001$) and urban children ($P < 0.011$) whereas subacute and chronic osteomyelitis were more likely among the older children ($P < 0.001$) and rural residents ($P < 0.011$). *Staphylococcus aureus* was the most common isolated pathogen. Anemia, septic arthritis, and pathological fractures were the three top complications observed. Fifty patients (65.8%) recovered and adjudged cured, 9 (11.8%) were lost to follow-up, and 17 (22.4%) were unable to afford the financial cost of the treatment. **Conclusion:** In our environment, chronic pyogenic osteomyelitis sequel to acute hematogenous bone infection in childhood is common. Poverty is also a limiting factor in its definitive treatment. These calls for a policy response aimed at improved care and preventive strategies based on the observed pattern.

Keywords: *Bone infection, childhood pediatric, Nigeria, osteomyelitis, pyogenic*

Introduction

Pyogenic osteomyelitis is an inflammation of bone and its marrow content in response to invasion by bacteria organisms that reach bone via hematogenous route, from a contiguous focus or by direct traumatic or iatrogenic inoculation. It is a common health problem among children in developing countries.[1,2] In developed countries, the annual incidence is low and on the decline.[3] In general, growing children are the most vulnerable to pyogenic bone infection. However, in a recent published report, the relatively higher risk of osteomyelitis among Polynesians and Maori children compared to European children in New Zealand[2] indicates ethnicity bias in the risk of childhood bone infection. The destruction of physis resulting in growth arrest and deformities, as well as an increased risk of irreversible joint damage in children, has serious implications in short- and long-term morbidity associated with childhood pyogenic osteomyelitis.

Pyogenic bone infection, depending on the duration, presents in two distinct clinical forms, acute and chronic osteomyelitis. These two distinct clinical forms represent one-disease state, which in reality is a spectrum of pathological features that reflect a balance between the type and virulence of causative organism, host immune response, and the presence of predisposing factors.[4,5]

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Thus, acute pyogenic bone infection (duration <2 weeks) is characterized by pus formation and systemic reaction of varying degree of severity whereas chronic pyogenic bone infection (duration 6 or more weeks) is characterized by persistence of infecting organism amid sequestrum and other necrotic tissues.[5] In between these two distinct clinical forms is subacute osteomyelitis that can present primarily without general reactions where the virulence of the organism and host resistance are in equilibrium,[6] or in form of a protracted acute bone infection (between 2 and <6 weeks duration from onset of symptoms) that either resolves or progresses to chronicity.

Childhood pyogenic osteomyelitis in its acute stage is usually curable by early recognition and adequate treatment.[5] Inadequate and delayed management, missed diagnosis, and immune compromise are risk factors associated with transition of acute pyogenic osteomyelitis to chronicity.[5,7] Thus, the effectiveness of different levels of health care in prevention, timely recognition, and adequate intervention in childhood pyogenic osteomyelitis has implications on the outcome and distribution of clinical forms of presentation in a setting.

Most of the published reports on pyogenic bone infection in children focused on either of these clinical forms of presentations.[1,2,6,8-11] Overall, there is a paucity of published study that defines the pattern of childhood pyogenic osteomyelitis as one-disease state with a spectrum of pathological features.[12,13] The limited data have necessitated this study aimed at determining the pattern and outcome of childhood pyogenic osteomyelitis in a low-resource setting.

Materials and Methods

This was a retrospective review of database of all childhood pyogenic osteomyelitis seen in Federal Teaching Hospital Abakaliki between January 2005 and December 2015. Federal Teaching Hospital Abakaliki came into existence in January 2011 after a successful merger of Ebonyi State University Teaching Hospital and Federal Medical Centre Abakaliki; it is one of the major teaching hospitals in the south eastern parts of Nigeria. An approval for this study was given by the hospital ethics and research committee (Ref no FETHA/REC/VOL1/2017/494). All the patients with pyogenic osteomyelitis seen in the hospital within the period were identified by searching the hospital admission and outpatient attendance database. Then, the case note of these patients aged 18 years and under was retrieved from the Medical Records Unit and was the source of data. Relevant information such as demographic data, place of abode of patients, initial health facility visited, predisposing factors, route of infection, etiological bacterial agent, duration of symptoms, bone involvement, clinical features, comorbid factors, laboratory and radiological findings, treatment, and outcome were extracted from these case notes.

Diagnosis of pyogenic osteomyelitis was confirmed by radiological assessment. Patients who presented earlier than 10 days after onset of symptoms had a repeat radiograph after 14 days from the onset of symptoms to demonstrate definitive radiological evidence of bone infection. Isotope scanning facility was not available within the period under review. Acute osteomyelitis is the clinical form of bone infection with duration of onset of symptoms ≤2 weeks. Subacute osteomyelitis included primary subacute forms of insidious onset without any general reaction,[6] and the ones that started as acute bone infection that has lasted for >2 to <6 weeks from the onset of symptoms. Chronic osteomyelitis exists when infection last >6 weeks with radiological evidence of sequestrum, sclerosis, and osteomyelitis associated with foreign bodies.

Data analysis was carried out with Statistical package for the Social Sciences (SPSS) version 16 (SPSS Inc; Chicago, IL., USA). Frequency tables, cross tabulation, and Pearson's Chi-square test of significance was used. For all statistical analysis, $P < 0.05$ was considered statistically significant.

Results

There were 76 patients with diagnosis of pyogenic osteomyelitis seen in the hospital within the 11-year period. The female-to-male ratio was 1:1.7. The patients' age ranged from 1 month to 18 years, and the average age was 9.9 ± 5.1 years. Pyogenic bone infections were acute in 16 (21.1%), subacute in 10 (13.2%), and chronic in 50 (65.8%) patients. Forty-two (84%) of the patients who presented with chronic hematogenous osteomyelitis had initial acute attack that was either neglected or poorly treated.

From Table 1, there was a higher rate of acute pyogenic bone infection among the females (25%) compared to males (18.8%), and a higher rate of chronic infection in males (68.8%) than in females (60.7%). Infants were significantly more likely to present in the acute phase of bone infection whereas the older children were more likely to present with chronic bone infection ($P < 0.001$) as shown in Table 1. Furthermore, from Figure 1, the peak age incidence of acute osteomyelitis was in the first 2 years of life whereas the peak age incidence of subacute osteomyelitis was in 6–10 years of age. The incidence of chronic osteomyelitis doubled after the first 2 years of life and tripled at the age of 11–15 years.

From Table 1, patients resident in urban area were significantly more likely to present in the acute phase of

Table 1: Childhood pyogenic osteomyelitis by clinical form and population characteristics

	Clinical form			Total (%)	χ^2	*P*
	Acute (%)	Subacute (%)	Chronic (%)			
Age (years)						
0-2	6 (66.7)	1 (11.1)	2 (22.2)	9 (11.8)	27.252	0.001
>2-5	3 (30.0)	1 (10.0)	6 (60.0)	10 (13.2)		
6-10	5 (25.0)	6 (30.0)	9 (45.0)	20 (26.3)		
11-15	2 (8.0)	1 (4.0)	22 (88.0)	25 (32.9)		
16-18	0	1 (8.3)	11 (91.7)	12 (15.8)		
Sex						
Female	7 (25.0)	4 (14.3)	17 (60.7)	28 (36.8)	0.545	0.762
Male	9 (18.8)	6 (12.5)	33 (68.8)	48 (63.2)		
Residency						
Rural	6 (11.5)	8 (15.4)	38 (73.1)	52 (68.4)	9.030	0.011
Urban	10 (41.7)	2 (8.3)	12 (50.0)	24 (31.6)		

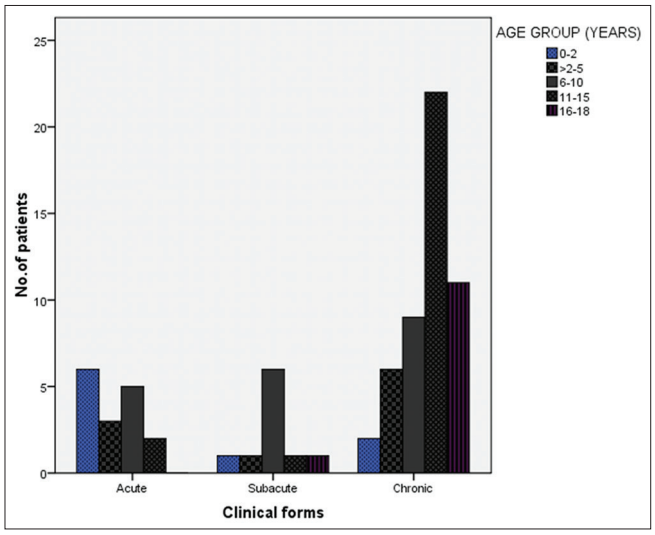

Figure 1: Childhood pyogenic osteomyelitis by age distribution and clinical form

pyogenic osteomyelitis whereas those resident in rural areas were more likely to present in the subacute and chronic phase of the infection ($P < 0.011$).

Hematogenous spread of infection accounted for osteomyelitis in 72 (94.7%) of patients whereas open injury of the extremity was the route of infection in 4 (5.2%) of the patients. There was a recent history of infection in a distant focus, skin infection and otitis media in 2 and 1 of the patients, respectively. There was an associated recent history of blunt extremity injury from falls and during contact sports in 28 (36.8%) patients. The 0–2, >2–5, 6–10, 11–15, and 16–18 years age group accounted for 2, 3, 9, 11, and 3 of the 28 patients with recent history of trauma, respectively. Sickle-cell disease and malnutrition were predisposing and comorbid conditions observed in 10 (13.2%) and 1 (1.3%) of the patients, respectively.

As shown in Table 2, swelling (56.6%), pain (53.9%), and draining sinus (48.7%) were the three top presenting clinical features. There was a positive history of pain in all the 16 patients with acute pyogenic bone infection. Pain and swelling were the two top symptoms in subacute bone infection whereas draining sinus and swelling were the two top presenting clinical features in chronic pyogenic osteomyelitis.

In these 76 patients, 67 (88.2%) had monostotic pyogenic osteomyelitis whereas 9 (11.8%) had polyostotic involvement giving a total of 85 infected bones. The incidence of polyostotic infection correlated significantly ($P < 0.009$) with the clinical form the disease state – 31.2%, 20%, and 4% in acute, subacute, and chronic pyogenic osteomyelitis, respectively.

As shown in Figure 2, the bones affected were 45 on the right and 40 on the left. Infection involved 20 bones in the upper extremity and 64 bones in the lower extremity, the tibia accounted for 35 (41.2%) of the bones. In the upper extremity, the bones on the right were more involved than on the left (17 vs. 3) whereas in the lower extremity the bones on the left were more involved than the right (36 vs. 28).

The duration of symptoms before presentation to the hospital was in a range of 1 day to 120 months with a mean of 11.9 ± 2.45 months for the entire patients. The mean duration of symptoms before presentation to hospital for patients with acute, subacute, and chronic osteomyelitis was 6.5 ± 0.04 days, 3.27 ± 1.17 months, and 17.59 ± 3.5 months, respectively. Prior to presentation to the teaching hospital, 30 (39.5%), 6 (7.9%), 4 (5.3%), and 10 (12.7%) of the patients had care from traditional bone setters/herbalist (indigenous people without formal medical training but who are easily accessible to patients with musculoskeletal injury and disorders), patent medicine dealers, primary health centers, and private/general hospitals, respectively. Among the 50 patients with chronic osteomyelitis, 20,

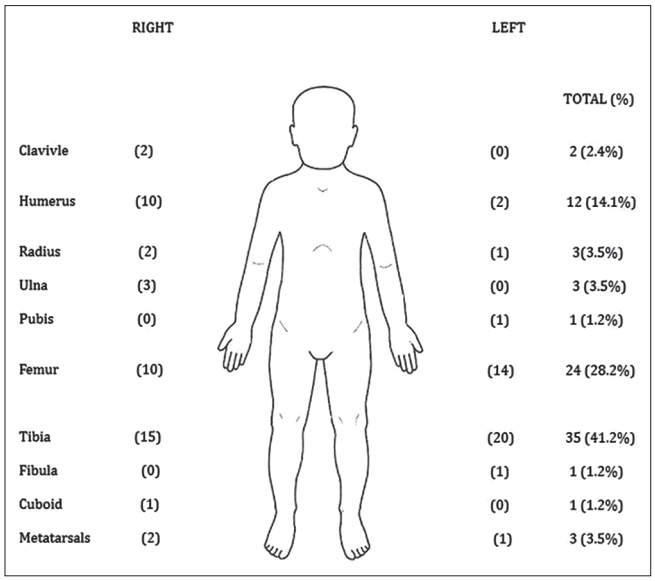

Figure 2: Distribution of the 85 bones involved in childhood pyogenic osteomyelitis

5, 3, and 5 of them received care in the acute stage of bone infection from traditional bone setters/herbalist, patent medicine dealers, primary health centers, and private/general hospitals, respectively, whereas 17 of them had no care.

As shown in Table 3, *Staphylococcus aureus* was the most common causative organism and was isolated in 34 (42%) of the patients, the culture obtained from pus and bone aspirate yielded no growth in 26 patients. Multiple growth was observed in 6 (7.9%) of the patients. On presentation to the hospital, the initial erythrocyte sedimentation rate (ESR) of entire patients ranged from 6–150 mm/h with a mean of 66.4 ml/h. The ESR was ≥20 mm/h in 86% of the patients. The mean ESR in acute, subacute, and chronic osteomyelitis at presentation was 78.22, 38.33, and 67.60 mm/h, respectively.

As shown in Table 4, the most common radiologic type observed was sequestrum with structural/mature involucrum (34.2%) whereas Brodie's abscess was the least (1.3%).

As shown in Table 5, the entire patient treated had antibiotics for a minimum of 6 weeks; sequestrectomy was the most common surgical operation intervention. Plaster of Paris cast and skin traction immobilization were applied in 6 and 2 patients, respectively.

Anemia, septic arthritis, and pathological fractures were the three top complications observed, the involvement of radius and ulna resulted in a synostosis in one of the patient as shown in Table 6. The incidence of anemia correlated ($P < 0.03$) to the clinical form; in acute, subacute, and chronic bone infections, it was 7/16 (43.8%), 6/10 (60%), and 11/50 (22%), respectively.

Table 2: Presenting clinical features in childhood pyogenic osteomyelitis

	Acute (*n*=16)	Subacute (*n*=10)	Chronic (*n*=50)	Total (%)
Swelling	10	8	25	43 (56.6)
Pain and/or irritability	16	8	17	41 (53.9)
Draining sinus	0	0	37	37 (48.7)
Fever	11	6	5	22 (28.9)
Limping	8	2	11	21 (27.6)
Extremity ulcers	0	1	10	11 (14.5)
Anorexia	2	2	1	5 (6.6)

Table 3: Isolated causative bacteria in patients*

Bacteria	Number of patients (%)
Staphylococcus aureus	34 (42)
Pseudomonas aeruginosa	7 (8.6)
Escherichia coli	4 (4.9)
Klebsiella	4 (4.9)
Proteus	3 (3.7)
Streptococcus	3 (3.7)
No growth	26 (32.1)
Total	81 (100)

*Multiple growths recorded in six patients

Table 4: Distribution of childhood pyogenic osteomyelitis by radiographic features

Radiographic types	Number of patients (%)
Periosteal reaction/elevation	16 (21.1)
Localized cortical sequestrum	8 (10.5)
Sequestrum with structural involucrum*	26 (34.2)
Sequestrum without structural involucrum	10 (13.2)
Sclerotic lesion	13 (17.1)
Lytic lesions	2 (2.6)
Brodie's abscess	1 (1.3)

*Structural involucrum is mature involucrum, adequate to support the limb against gravity

Table 5: Distribution of treatment modalities administered to patients*

Treatment	Number of patients (%)
Sequestrectomy + antibiotics	19 (32.2)
Incision and drainage and antibiotics	17 (28.8)
Sequestrectomy + fasciocutaneous flap + antibiotics	2 (3.4)
Curettage + antibiotics	1 (1.7)
Antibiotics	20 (33.9)
Total	59 (100)

*Seventeen patients (22.4%) were unable to receive care after diagnosis due to financial constraint

All the bones complicated with pathological fractures presented with chronic osteomyelitis.

The patients were followed up for a year and there was full recovery in 50 (65.8%) of them whereas nine

Table 6: Complications of childhood pyogenic osteomyelitis

Complication	Number of patients (%)
Anemia	24 (31.6)
Suppurative arthritis	9 (11.8)
Pathological fracture	3 (4.0)
Septic shock	2 (2.63)
Limb shortening	1 (1.32)
Radius-ulna synostosis	1 (1.32)
Genus valgus deformity	1 (1.32)
Total	41 (54)

patients (11.8%) were lost to follow-up. Seventeen patients (22.4%) were unable to afford the financial cost of treatment (operative surgical intervention) after investigations and diagnosis;16 and 1 of the patients in this category had chronic and subacute osteomyelitis, respectively.

Discussion

Childhood pyogenic osteomyelitis is an important health concern in our environment. The preponderance of the male child in this study is similar to the findings in previous published reports.[2,12,13] In this study, the preponderance of chronic osteomyelitis in the distribution of clinical form of bone infection is at variance with the predominance of acute osteomyelitis reported by Okoroma and Agbo in Enugu,[12] Yeh *et al*. in Taiwan,[13] and Sáez-Llorens *et al*. in Panama.[14] The exact reason for this variation is not apparent. However, more than two-third of the patients in this series were rural dwellers, more likely to present in chronic form of the disease state as shown in Table 1. This may be a factor for the preponderance of chronic osteomyelitis observed in this study. Acute and chronic osteomyelitis observed [Table 1] to be significantly more in infants and older children, respectively, is similar to the findings reported by Yeh *et al*.[13] The peak age incidence of subacute osteomyelitis in this study differs from peak age incidence of 17 years reported by Harris and Kirkaldy-Willis[6] for primary subacute osteomyelitis. In this study, majority of the subacute cases had initial acute attack that continued into subacute phase, a group excluded by Harris and Kirkaldy-Willis.[6] This perhaps is the reason for the difference in peak age incidence observed.

In this series, the recent history of trauma elicited in about a third of the patients is close to 30% in a previously published report.[15] This also calls for public enlightenment on the importance of bringing children with bone pain, fever, and a recent history of fall to the hospital for early diagnosis and treatment.

In this study, sickle-cell disease as a predisposing and comorbid condition was common among the patients. This emphasizes the importance of determining the genotype of every child with osteomyelitis in this setting and calls for a high index of suspicion for osteomyelitis among sickle-cell disease patients presenting with bone pain. The presenting clinical features observed in Table 2 were not different from the ones documented in previously published reports.[11,12]

The incidence of polyostotic pyogenic osteomyelitis and its significant correlation with the clinical form of disease state, a higher rate in acute than chronic infection, in this series is similar to the findings in a previously published report.[12] The exact reason for this is not apparent. However, the overwhelming sepsis (necessitating earlier presentation) that is more likely in polyostotic infection might be the reason for its higher incidence in acute phase of disease state. The involvement of more of bones in the lower than upper extremity is similar to the finding in other published reports.[12,13] However, the tibia observed as most common bone involved is at variance with the predominance of femur reported by Okoroma and Agbo[12] and Yeh *et al*.[13] as the most common bone involved in childhood osteomyelitis. The exact reason for this variation is not evident. As shown in Figure 2, the right and left side distribution of bone infection in the upper and lower extremity is similar to the pattern of joint involvement in childhood pyogenic septic arthritis in a recently published report from a similar setting in Nigeria.[16] In the same report, the distribution of joints involved in sepsis correlated with the documented pattern of childhood extremity trauma. Trauma of varying degree of severity is a well-known risk factor for bone and joint infection in children.[15,17] Thus, the pattern of trauma in children in this setting could be a possible reason for the observed pattern of bone involvement in pyogenic osteomyelitis.

The mean duration of symptoms prior to presentation to hospital for acute osteomyelitis in this series, which differs from 3.4 days reported by Shivarathre *et al*. in Liverpool, United Kingdom,[10] indicates that late presentation is common among our patients. In a recently published report from a similar setting, delayed presentation has been attributed to health-seeking behavior, where care sought from traditional bone setters and patent medicine dealers prior to presentation in the hospital is common among patients with musculoskeletal infection.[16]

S. aureus observed in Table 3 as the most common isolated pathogen is not different from the finding in some similar previously published studies.[2,3,10,12,14]

The initial ESR on presentation to hospital that was raised in 86% of patients is similar to the findings reported in other previously published reports.[2,12] The range and the mean ESR for acute and chronic bone infection were similar to the findings reported by Okoroma and Agbo in Enugu.[12] However, the mean ESR for acute osteomyelitis (78.2 mm/h) is much higher than 40.63 mm/h reported by Shivarathre *et al*. in Liverpool.[10] In childhood bone infection, the rise in ESR peaks in 3–5 days.[18] The difference in the mean duration of symptoms prior to presentation to hospital for acute bone infection in this setting (6.5 days) and in Liverpool (3.4 days) might be a possible reason for the higher mean ESR observed in this study.

Anemia is a common complication of osteoarticular infections in children, and this has been attributed to hemolysis and marrow toxicity associated with sepsis.[19] Thus, the incidence of anemia in this study was high in the acute phase and increased further in the subacute phase, then dropped to half in the chronic phase that the causative pathogens have been well localized in the bone amid sequestrum and other necrotic tissues. The destruction of bone associated with chronic osteomyelitis predisposes the patients to the risk of pathological fracture, especially when the involucrum is not adequate or mature enough to take over the functions such as weight bearing. In a previously published report, chronic osteomyelitis was the most common cause of pathological fracture in children in southwestern Nigeria.[20] Thus, is not surprising that pathological fracture is one of the top three complications in this series.

In this series, the percentage of those who recovered fully and adjudged cured is within the range in other published reports.[11,12] The inability of seventeen patients (22.4%) to have operative surgical intervention after investigations and diagnosis due to financial constraint indicates that poverty is an important factor in the morbidity associated with pyogenic bone infection in our environment. The bulk of this category of patients had chronic pyogenic osteomyelitis that was sequel to acute hematogenous bone infection. In this study, majority of the patients with chronic osteomyelitis received care from traditional bone setters/herbalist in the acute phase of bone infection. The management of musculoskeletal disorders, by these practitioners, using traditional splint, balm, and herbs[21] is too far from adequate treatment required to cure acute pyogenic bone infection and reduce the risk of its transition to chronicity. Thus, the need to enlighten the public on the importance of using available resources for early presentation to hospitals with capacity for prompt and adequate care of acute bone infection in children cannot be overemphasized.

The limitations of this study include its being a hospital and single-center based one. The data obtained may not be a representation of the entire population.

Conclusion

In our environment, childhood chronic pyogenic osteomyelitis sequel to acute hematogenous bone infection is common. Poverty is also a limiting factor in its definitive treatment. These call for a policy response aimed at improved care and preventive strategies based on the observed pattern.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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