ORIGINAL ARTICLE

Chronic Osteomyelitis of the Long Bones

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ABSTRACT

Background: Chronic osteomyelitis is a challenging condition both to the clinician and the patient. Despite the advances that have been made in the areas of antibiotic management and operative treatment, the condition is still associated with high incidence of recurrence and high morbidity rate.

Objective: The aim of the study is to review the incidence, pattern, clinical features and outcome of the treatment of chronic osteomyelitis of the long bones in a tertiary Hospital in South-Eastern Nigeria.

Methodology: The study was conducted in a tertiary health centre located in a sub-urban area in the South–Eastern region of Nigeria. It was retrospective in nature and involved consecutive patients who presented to the hospital with chronic osteomyelitis of any of the long bones over a two year period. Clinical data were obtained from the hospital records and analyzed.

Results: A total of 57 patients were recruited in the study, with a male to female ratio of 1.7:1. The mean age at presentation was 35.6 years (range: 3-80 years). Osteomyelitis was most common in the first and second decades of life (42%). Trauma was the most common cause of osteomyelitis (65%), of which road vehicle crashes accounted for 54% of cases. Out of these, 67.6% were due to open injuries. The most common bone affected was the tibia (44%), while the least affected bone was the radius (7%). Sixty-nine percent of the patients presented to the hospital at least 12 months after the onset of the problem, while the most common isolated micro-organism was *Staphylococcus aureus* (38.6%). The cure rate for chronic osteomyelitis was 90.7%.

Conclusion: From this study, chronic osteomyelitis of the long bones was mostly caused by open fractures resulting from motor vehicular crashes, and predominantly affects the tibia. The most frequently isolated pathogenic organism was *Staph. aureus*. Most of the patients had eradication of the infection following appropriate treatment.

Key words: *Osseous infection, Trauma, South-East Nigeria, Tibia, Staphylococcus aureus.*

INTRODUCTION

Chronic osteomyelitis is one of the most challenging conditions for the clinician due to the long course of the disease, its complex treatment requirements and high incidence of recurrence. This is despite the advances that have been made both in the areas of antibiotic management and operative treatment. Osteomyelitis is an infection of bone and bone marrow. The manifestations differ from case to case with regard to duration, aetiology,

pathogenesis, extent of bone involvement and type of patient. The patient (host) can be an infant, a child, an adult, or an immune compromised host.

The bacteria gain access into the bone through the blood stream (haematogenous), through direct inoculation following fractures or treatment of fractures or from contiguous focus of infection. The most common causes of direct inoculation are penetrating injuries following trauma and surgical contamination.[1,2,3,4] Contiguous focus osteomyelitis commonly occurs in patients with severe vascular disease as seen in diabetic foot disease.

A number of local and systemic factors may predispose an individual to the development of osteomyelitis and also affect their ability to elicit an effective response to infection and treatment.[5,6,7,8]

Osteomyelitis can be acute or chronic. Acute osteomyelitis manifests as a suppurative infection accompanied by oedema, vascular congestion, and small vessel thrombosis. When both medullary and the periosteal blood supplies are compromised, large areas of dead bone (sequestra) may be formed.[9] If a prompt and aggressive treatment with antibiotic and possibly surgery are instituted, acute osteomyelitis can be arrested before dead bone formation, which is the hallmark of chronic osteomyelitis.[10,11]

The clinical characteristics of chronic osteomyelitis vary depending on geographical location and changing trends. It is more common in developing than developed countries.[12,13,14] This may be explained by differences in socio-economic status, lifestyle and quality of medical care. There has been a marked change in the clinical picture over the past decades.[15] In the past it resulted predominantly as a follow up to poorly managed acute haematogenous osteomyelitis.[16,17] Increasingly however, it now results mainly from trauma, orthopaedic implants and diabetic foot. [18, 19, 20,21,22,23]

The treatment of chronic osteomyelitis involves a team approach which should include an infectious disease specialist, an orthopaedic surgeon, a plastic surgeon, a nutritionist, and other physicians as appropriate. The appropriate treatment for the condition includes adequate drainage, thorough debridement, obliteration of dead space, wound protection, adequate soft tissue cover, restoration of blood supply, antibiotic therapy and stabilization.[24,25,26] In addition, an attempt is made to improve the nutritional, medical, and vascular status of the patient and provide optimal treatment of any underlying disease.

The aim of the present study is to review the incidence, pattern, clinical features and result of the treatment of chronic osteomyelitis of the long bones in our institution.

METHODOLOGY

This retrospective study of chronic osteomyelitis of long bones was conducted at the Imo State University Teaching Hospital, Orlu located in a suburban area in the South-Eastern part of Nigeria. Patients' data were collected manually from the medical records of the hospital. The study period was from January 1, 2013 to December 31, 2015. Consent from the patients was waived due to the retrospective nature of the study but their personal information were omitted to ensure their anonymity. Ethical approval was obtained from the ethical committee of the hospital.

Inclusion and exclusion criteria

In this study, chronic osteomyelitis was defined as the persistent infection of bone and bone marrow for at least 3 months. The study involves only the long bones in the body. The diagnosis was made on the basis of preoperative values of white blood cell count (WBC), erythrocyte sedimentation rate (ESR), plain radiographs of affected bone, and culture results of intra-operative bone biopsy. Serial post-operative values of WBC, ESR and X-ray results were used to monitor the progress of the disease, together with the clinical parameters. The eligible medical records were those of patients with a

diagnosis of long bone chronic osteomyelitis, which contain one or more of the following information: gender, age at first presentation, site of infection, duration of illness as at the time of presentation, aetiology, treatment before presentation, pre-operative values of serum WBC, ESR, and X-ray result; treatment strategies and whether or not the infection was eradicated. Excluded from the study were patients who declined surgical intervention, those who received only conservative treatment and all those managed for just acute osteomyelitis.
Data analysis was done using the SPSS 17.0 software (SPSS Inc, Chicago, IL).

RESULTS
The medical records of 102 patients with osteomyelitis were initially collected. With a further review, only 57 cases met the inclusion criteria and these were recruited into the study.

The study included 36 males and 21 females, with a gender ratio of 1.7: 1.The age range at first presentation was 3-80 years. The highest number of cases were recorded in the first two decades of life (42.1%, 24 cases), while approximately 82% of the patients with the disease were 3-60 years (47 cases), see table 1.

Using the classification system by Waldvogel, *et al.,* traumatic osteomyelitis (including post-operative) was the most common variety (64.9%, 37cases).[27] Infection due to haematogenous spread accounted for (28.1%, 16cases), while chronic osteomyelitis secondary to contiguous focus of infection was seen in 4 patients (7%), see figure 1.

The majority of the cases of post- traumatic osteomyelitis were as a result of motor vehicular crash (54%, 20 cases), followed by blunt injury (13.5%, 5 cases) and gun-shot injury (13.5%, 5 cases); while post-operative causes accounted for 4 cases (10%). Three cases (8%) were due to unspecified causes (Table 2). Also 67.6% (25 cases) of the cases of post-traumatic osteomyelitis were due to open injuries, while the rest were due to closed injury.

The total number of patients with infection in the lower limb was 45 (79%), while for the upper limbs, there were 12 patients (21%). The most frequent site of infection however, was the tibia (44%, 25 cases), followed by the femur (28%, 16 cases), see Figure 2. The tibia was also the most common site for post-traumatic osteomyelitis, while the femur on the other hand was the most common site for the haematogenous variety. The foot bones were the most common site for osteomyelitis secondary to contiguous focus of infection.

Most of the patients presented after 12 months of the onset of symptoms (68.4%, 39 cases); 12 patients (21%) presented before 6 months, while the rest (10.5%, 6 cases) presented between 6 and 12 months of the onset of symptoms.

The most frequently isolated micro-organism was *Staphylococcus aureus* (38.6%, 22 cases), followed by *Escherichia coli* (8.8%, 5 cases) and *Proteus spp.* (3.5%, 2 cases). In 28 cases (49.1%), no organism was isolated (figure3).

Out of the 57 patients in the study, 2 patients died, 1 patient had a below knee amputation, while the rest were followed up for at least one year. Therefore, 54 patients completed the study. The cure rate (no relapse within 1 year) was 90.7% (49 cases).

Table 1. Age distribution

Age (years)	Frequency	Percentage
0-10	10	17.5
11-20	14	24.6
21-30	1	1.8
31-40	9	15.8
40-50	6	10.5
51-60	7	12.3
61-70	4	7.0
<70	6	10.5
Total	**57**	**100**

Table 2.
Post- traumatic causes of osteomyelitis

Injury type	Frequency	%
Motor vehicle crash	20	54.1
Blunt injury	5	13.5
Gunshot	5	13.5
Post-Operative	4	10.8
Non-specified	3	8.1
Total	**37**	**100**

Figure 1. Aetiology

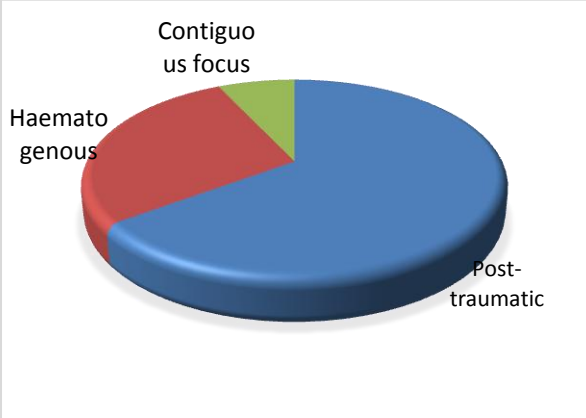


Figure 2. Site of infection

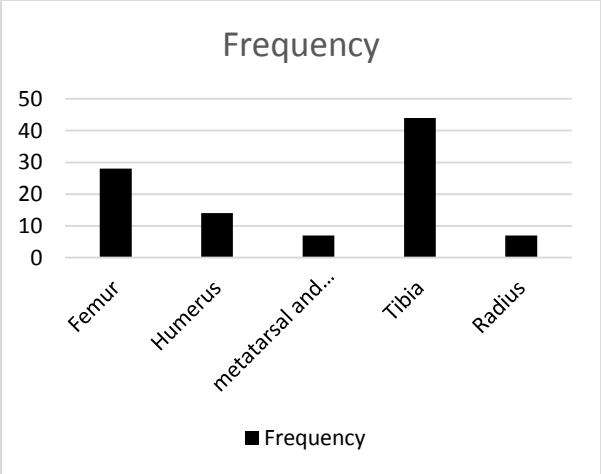
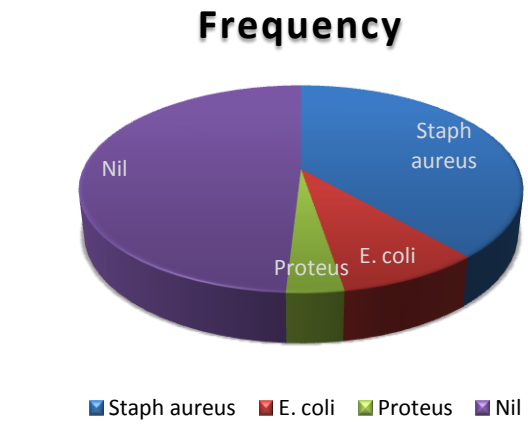


Figure 3. Isolated micro-organisms



DISCUSSION

The incidence of osteomyelitis has been on the increase worldwide. In a recent study in the United States of America by Kremers, *et al.*, the incidence was reported to have more than doubled when the values between 2000 and 2009 were compared to those between 1969 and 1979 (24.4/100,000 vs. 11.4/100,000).[28] Similar results were obtained in studies from other geographical locations.[29] This may not be unconnected to the increasing incidence of road traffic crashes, industrial accidents, and use of orthopaedic implants.[30] Traumatic osteomyelitis is the most common variant in our study as seen in other developing countries.[31] In more advanced countries, however this is not the case. As reported by Kremers and colleagues in their study, contiguous focus infection due to diabetes mellitus is the commonest variety in America.[28] This is likely due to the difference in lifestyle, socio-economic status, and quality of medical services between the developed and developing countries.

We observed that the most common site for osteomyelitis of the long bones was the tibia. It was also the most common site for traumatic osteomyelitis. In earlier studies in this environment, the femur was the most commonly affected site.[31,32] This difference may be due to changing trends as the predominant aetiology shifts from haematogenous to traumatic. The tibia being mainly subcutaneous is commonly affected by fractures. The findings from a number of series from Europe and America also suggest that the tibia is the most common bone affected.[4,28] Haematogenous osteomyelitis on the other hand affected the femur predominantly (53%). This may be due to the fact that the femur is highly vascularized. All the cases of contiguous focus infection were due to diabetes mellitus and occurred in the foot.

The most common causative micro-organism was *Staphylococcus aureus* (36%). This is similar to the findings by a number of other authors.[5,33,] However, a high proportion of cases (52%) had negative cultures. Kremers *et al*. in their study on the trends in the

epidemiology of osteomyelitis spanning over a period of 40 years, noted an increase in the proportion of patients with culture- negative cases over time.[28] The reason for this cannot be explained by this work. It may likely be due to antibiotic abuse by most of the patients as a number of them may have indulged in self-medication or visited quacks before presentation. As 70% of the patients presented at least 12 months after the onset of symptoms, it is likely that they may have indulged in some unconventional treatments before presentation. This may range from visiting quacks and bone-setters to trying various forms of antibiotics for self-medication. It is advised that patients with chronic osteomyelitis should stop antibiotic use for at least two weeks before culture. If a negative culture result is obtained, it is recommended that the culture conditions be changed for fungal and acid- fast bacillus.[30]

Treatment of osteomyelitis of the long bones should take into consideration both systemic and local conditions. The systemic factors include the optimization of the nutritional and immunological status of the patient while preparing the patient for surgery. In our study, all the patients underwent surgery as all those managed conservatively were excluded from the study. The local effects of the infection on bone are taken care of at surgery. The general procedure for management of infection in long bones comprises of radical debridement, systemic and local antibiotic administration, bone and soft tissue reconstruction, and skeletal stabilization.

Antibiotic treatment should be based on the identification of pathogens from bone cultures at the time of bone biopsy or debridement.[34,35] Bone cultures are obtained first before commencement of antibiotics administration which is based on suspected pathogens. The drugs are then modified as soon as the organisms are identified. Traditionally, antibiotic treatment of osteomyelitis is given over a period of 4 to 6 week.[35] In the present study antibiotics were given for a total of 4 to 6 weeks according to our hospital policy, with the first two weeks being through the intravenous route. However, a recent study showed that similar results can be achieved by either oral or parenteral antibiotic administration in osteomyelitis if the bacteria are sensitive to the antibiotic used.[36]

In our study, the cure rate for osteomyelitis of long bones within one year of follow up was 90.7%. This value is higher than what is obtained by some other authors in the developing countries.[30,34] This seemingly high success rate in our study should however be viewed with some caution as the patients were followed up for only one year. Recurrence can occur many months and even years after the initial successful treatment. Additionally the limited sample size and the fact that cases managed by conservative measures were excluded from the study may have also influenced the result.

CONCLUSION

This study showed that the most common type of chronic osteomyelitis of long bones was traumatic osteomyelitis. They were mainly as a result of open fractures from motor vehicular crashes. The condition affected males predominantly and favored the lower limbs. The most commonly detected micro-organism was *Staphylococcus aureus*, while majority of the patients had eradication of the infection during the study period.

REFERENCES

1. McNally AM, Small OJ, Tofighi GH, *et al*. Two stage management of chronic osteomyelitis of long bones: The Belfast technique. *J Bone Joint Surg* 1993; 75B (3): 375-380
2. McAllister TA. Treatment of osteomyelitis. *Br J Hosp Med* 1994; 12: 535-545
3. Anthony JP, Mathes SJ. Update on chronic osteomyelitis. *Clinic Plastic Surg* 1991; 18(3): 515-523
4. Solomon l, Warwick D, Nayagam S, editors. Appleys Systems of Orthopaedics and Fractures, 8th ed. London: Arnold; 2001. p. 27-48

5. Warner WC Jr. Osteomyelitis. *In*: Jones L, Canale T, Canale ST, editors. Campbell's operative orthopaedics. 9th ed. St Louis (MO): Mosby; 1998
6. Gillespie WJ. Epidemiology in bone and joint infections. *Infect Dis Clin North Am* 1990; 4: 361-376
7. Epps CHJ Bryant DD, Colles MJ, *et al*. Osteomyelitis in patients who have sickle- cell disease: Diagnosis and management. *J Bone Joint Surg Am* 1991; 73: 1281-94
8. Moutschen MB, Scheen AJ, Lafebre PJ. Impaired immune response in diabetes mellitus: analysis of the factors and mechanisms involved. Relevance to the increased susceptibility of diabetic patients to specific infections. *Diabetes Metab* 1998; 18: 187-201
9. Emslie KR, Ozanne NR, Nade SM. Acute haematogenous osteomyelitis: an experimental model. *J Pathol* 1983; 141: 157-167
10. Lazzarini L, Mader JT, Calhoun J. Osteomyelitis in long bone. *J Bone Joint Surg Am* 2004; 86(10): 2305-2318.
11. Paakkonen M, Kallio PE, Peltola H. Shortened hospital stay for childhood bone and joint infections: analysis of 265 prospectively collected culture- positive cases in 1983-2005 *Scand J Infect Dis* 2012; 44(9): 683-688
12. Museru LM, McHaro CN. Chronic osteomyelitis: a continuing orthopaedic challenge in developing countries. *Int Orthop* 2001; 25:127–131
13. Lazzarini L, Mader JT, Calhoun JH. Osteomyelitis in long bones. *J Bone Joint Surg Am* 2004; 86-A: 2305–2318
14. Nade S. Acute and chronic osteomyelitis. *Surgery* 1997; 15(1): 248-252.
15. Walter G, Kemmerer M, Kappler C, *et al*. Treatment algorithms for chronic osteomyelitis. *Dtsch Arztebl Int* 2012; 109:257–264
16. Islam GTJ, Darton T, Townsend R. Bone and joint infections. *Surgery (Oxford)* 2013; 31:187–192
17. Sheehy SH, Atkins BA, Bejon P, *et al*. The microbiology of chronic osteomyelitis: prevalence of resistance to common empirical anti-microbial regimens. *J Infect* 2010; 60:338–343
18. Hogan A, Heppert VG, Suda AJ. Osteomyelitis. *Arch Orthop Trauma Surg* 2013; 133:1183–1196
19. Schenker MLYS, Baldwin KD, Ahn J, *et al*. Does timing to operative debridement affect infectious complications in open long-bone fractures? A systematic review. *J Bone Joint Surg Am* 2012; 94:1057–1064
20. Penn-Barwell JG, Bennett PM, Fries CA, *et al.* Severe open tibial fractures in combat trauma: management and preliminary outcomes. *Bone Joint J* 2013; 95-B: 101–105
21. Zimmerli W. Clinical presentation and treatment of orthopaedic implant-associated infection. *J Intern Med* 2014; 276:111–119
22. Trampuz A, Zimmerli W. Diagnosis and treatment of implant-associated septic arthritis and osteomyelitis. *Curr Infect Dis Rep* 2008; 10:394–403
23. Sagray BA, Malhotra S, Steinberg JS. Current therapies for diabetic foot infections and osteomyelitis. *Clin Podiatr Med Surg* 2014; 31:57–70
24. Paluska SA. Osteomyelitis. *Clinics in Family Practice* 2004. 6:127-156
25. Cierny G, Mader JT. The surgical treatment of osteomyelitis. In: Evarts CMC, editor. Surgery of the musculoskeletal system. New York: Churchill Livingstone; 1983. p. 15-35
26. Cierny G 3rd. Chronic osteomyelitis; results of treatment. *Instr Course Lect* 1990; 39: 495-508
27. Waldvogel F, Medoff G, Swartz M. Osteomyelitis: a review of clinical features, therapeutic considerations and unusual aspects. *N Engl J Med* 1970; 282:198–206.
28. Kremers HM, Nwojo ME, Ransom JE, *et al*. Trends in the epidemiology of osteomyelitis: a population- based study, 1969-2009. *J Bone Joint Surg Am* 2015 20; 97(10): 837-845.
29. Nan Jiang, Yun- fei Ma, Yi Jiang MM, *et al.* Clinical characteristics and treatment of extremity chronic osteomyelitis in Southern China. *Medicine (Baltimore)* 2015; 94(42)
30. Zhou J, Li Y, Wang QK, *et al.* Status of road safety and injury burden in China. *J Orthop Trauma* 2014; 28 Suppl 1:S41–S42
31. Onumiya JE, Onobowale BO. Outcome of chronic osteomyelitis in Nigeria. *Journal of Applied Basic Sciences* 2003; 1(1&2): 27-30
32. Katchy NA, Agu CT, Nwankwo EO. Chronic osteomyelitis in 110 patients. *Niger Postgrad Med J* 2000; 7(2): 49-53
33. Wordsworth P. Diseases of bone and joints: In Infections. *In:* Russel RCG, Williams NS, Bulstrode CJK, editors. Bailey and Love's Short Practice of Surgery. 24th ed. London: Arnold; 2004. p. 479-430
34. Eyichukwu GO, Anyaehie UE. Outcome of management of chronic osteomyelitis at National Orthopaedic Hospital, Enugu. *Niger J Med* 2009; 18(2): 194-198

35. Calhoun JH, Manring MM. Adult osteomyelitis. *Infect Dis Clin North Am* 2005 ; 19(4): 765-786
36. Conterno LO, Turchi MD. Antibiotics for treating chronic osteomyelitis in adults. *Cochrane Database Syst Rev* 2013; 9: Cd004439