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ORIGINAL ARTICLE

Behavior of osteomyelitis in pediatric patients

Comportamiento de la osteomielitis en pacientes pediátricos

Comportamento da osteomielite em pacientes pediátricos

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ABSTRACT

Introduction: osteomyelitis is an infection in the bone, most frequently affecting patients in pediatric ages, with a variety of behaviour on how to reach the bone, type of germ and host response. **Objective:** to describe the behaviour of a group of pediatric patients affected with osteomyelitis. **Method:** a descriptive observational study was conducted in 39 patients attended at the Hospital Provincial Pediátrico Dr. Eduardo Agramonte Piña in the city of Camagüey, from January 1 2018 to December 31 2022. Patients diagnosed with osteomyelitis throughout 60 months in total. **Results:** of the 39 patients studied, the male sex predominated over the female (2.2 to 1). The average age was 9 years old. The average length of hospital stay was 14.8 days. The most affected areas were the hands, femur and distal tibia. Surgical treatment predominated (2.2 to 1) in relation to conservative treatment. In the 86.4% of cases, hematogenous osteomyelitis was the most frequent infection. The transition to chronic osteomyelitis was the most common complication (33%). The most common isolated germ was staphylococcus aureus (in 85 % of the patients). The most indicated antimicrobials agents were cefazolin, amikacin and fosfomycin (Fosfocin). **Conclusions:** the results of this research provided some important elements base on the epidemiological point of view for pediatric patients with osteomyelitis, also allowed the implementation of diagnostic and therapeutic strategies in this group of patients.

Keywords: osteomyelitis; microbiology; pharmacological treatment; therapy; surgery

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RESUMEN

Introducción: la osteomielitis es una infección ósea, que afecta con frecuencia a pacientes en edades pediátricas, con comportamiento variado en dependencia de la vía de llegada al hueso, tipo de germen y respuesta del huésped. **Objetivo:** describir el comportamiento de un grupo de pacientes pediátricos con osteomielitis. **Método:** se realizó estudio observacional descriptivo en 39 pacientes atendidos en el Hospital Pediátrico Provincial "Dr. Eduardo Agramonte Piña" de la ciudad de Camagüey, en el periodo comprendido desde el primero de enero de 2018 al 31 de diciembre del año 2022, y un total de 60 meses con diagnóstico de osteomielitis. **Resultados:** de los 39 pacientes investigados predominó el sexo masculino sobre el femenino (2,2:1). La edad promedio fue de 9 años. El promedio de estadía hospitalaria fue de 14,8 días. Las zonas más afectadas fueron las manos, el fémur y tibia distal. Predominó el tratamiento quirúrgico (2,2:1) con relación al conservador. La vía hematógena de llegada al hueso fue la más frecuente en el 86,4 % de los casos. El paso a la cronicidad fue la complicación más encontrada (el 33 %). El germen aislado con mayor frecuencia fue el *Staphylococcus aureus* (en el 85 % de los enfermos). Los antimicrobianos más indicados fueron la cefazolina, amikacina y fosfocina. **Conclusiones:** los resultados obtenidos en la investigación aportan elementos importantes desde el punto de vista epidemiológico en pacientes pediátricos que sufren de osteomielitis, lo que permite implementar estrategias de diagnósticas y terapéuticas en este grupo de pacientes.

Palabras clave: osteomielitis; microbiología; tratamiento farmacológico; terapia; cirugía

RESUMO

Introdução: a osteomielite é uma infeção óssea, que afecta frequentemente afecta frequentemente doentes do grupo etário pediátrico, com um comportamento variado, dependendo da via de entrada no osso, do tipo de germe e da resposta do hospedeiro. **Objectivo:** mostrar o comportamento de um grupo de doentes pediátricos com osteomielite. **Método:** foi realizado um estudo observacional descritivo em 39 pacientes tratados no Hospital Pediátrico Provincial Dr. Eduardo Agramonte Piña, na cidade de Camagüey, no período de 1 de janeiro de 2018 a 31 de dezembro de 2022, e um total de 60 meses com diagnóstico de osteomielite.**Resultados:** dos 39 pacientes investigados, o sexo masculino predominou sobre o feminino (2,2 para 1). A idade média foi de 9 anos. A média de permanência hospitalar foi de 14,8 dias. As regiões mais acometidas foram as mãos, o fêmur e a tíbia distal. O tratamento cirúrgico predominou (2,2 para 1) sobre o tratamento conservador. A via hematogénica para o osso foi a mais frequente em 86,4% dos casos. A transição para a cronicidade é a complicação mais frequentemente encontrada (33%). O germe mais frequentemente isolado foi o Staphylococcus aureus (em 85% dos doentes). Os antimicrobianos mais frequentemente indicados foram a cefazolina, a amicacina e a fosfocina. **Conclusões:** os resultados obtidos na pesquisa fornecem elementos importantes do ponto de vista epidemiológico em pacientes pediátricos portadores de osteomielite, permitindo a implementação de estratégias diagnósticas e terapêuticas neste grupo de pacientes.

Palavras-chave: osteomielite; microbiologia; tratamento farmacológico; terapia; cirurgia

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INTRODUCTION

Osteomyelitis is the invasion of bone tissue by pathogenic germs. Its clinical, imaging and histological presentation is very varied and can lead to serious complications such as death in the patient.[1,2,3]

The route of arrival of the germ to the bone can be direct, hematogenous and by contiguity. Hence, symptoms and signs depend on the route, the germ involved and the host's defense.[4,5]

The diagnosis of patients with osteomyelitis is based on clinical, imaging, hematologic, histologic and molecular elements.[6,7]

Usually it is a pediatric patient presenting with general symptoms such as fever, general condition, tachycardia, tachypnea and dehydration. Locally, there is cutaneous hyperesthesia, pain on palpation of the affected metaphysis accompanied by increased volume and temperature.[8,9]

Imaging tests do not provide diagnostic elements in the early stages of the disease. Bone scintigraphy and positron emission tomography are the most sensitive and specific tests in the initial stages, but due to their high cost they are not routinely indicated studies.[10,11]

From the hematological point of view, there is leukocytosis and elevation of C-reactive protein, as well as in interleukin 6 determinations, among others.[12,13]

Treatment is based on three fundamental pillars: restoration of water and electrolyte balance, administration of antimicrobials and orthopedic management, the latter consisting of immobilization of the affected area and, if necessary, surgical decompression.[14,15]

Due to the frequency of this entity in the pediatric population, the authors of this research aim to show the behavior of a group of patients with osteomyelitis.

METHOD

A descriptive observational study was conducted in 39 patients attended at the Provincial Pediatric Hospital “Dr. Eduardo Agramonte Piña” in the city of Camagüey from January 1, 2018 to December 31, 2022, for a total of 60 months with the diagnosis of osteomyelitis.

The study population consisted of all patients less than 19 years of age admitted, treated and followed up by specialists of the Orthopedics and Traumatology service of the institution. Patients with open fractures, diseases that compromise the immune system and patients treated by other specialties were excluded from the study.

The patients were evaluated from the clinical, imaging (simple radiography and computed axial tomography), histological and microbiological points of view by taking tissue cultures from the surgical wound to determine the type of causal germ.

Conservative treatment by the Orthopedics and Traumatology specialty consisted of cast immobilization of the areas affected by the infection and parenteral administration of antimicrobials. Surgical treatment was justified in patients in whom purulent collection was demonstrated and in those who had limited response to conservative treatment with worsening of their symptoms and signs. Among the surgical modalities, decompression of the bone structure associated with debridement and toilette of the affected area was performed.

From the statistical point of view, the distribution of absolute and relative frequencies was used for qualitative variables; male-female sex ratio, arithmetic mean for quantitative variables such as age for both sexes and separately, in addition to hospital stay and conservative surgical treatment ratio. The clinical records were the primary source of information.

The SPSS statistical package version 23.0 was used for the calculations. The results were shown in three tables. The research was carried out in accordance with the ethical principles of the Declaration of Helsinki and was approved by the ethics committee and scientific council of the institution.

RESULTS

The study population consisted of 39 patients, of whom 27 were male and 12 were female with a ratio of 2.2:1. The average general age was 9 years, with a minimum age of one year and a maximum of 17 years. The average age of the male was higher than that of the female with 9.1 and 8.8 years respectively. The average hospital stay per admission was 14.8 days, with a minimum of three and a maximum of 41 days. The conservative surgical treatment ratio was 2.2:1 (Table 1).

Table 1 Cases behavior

Number of cases	39
Male to female sex ratio	2,2 a 1 (27/12)
Average age overall	9 (minimum 1, maximum 17)
Average age male sex	9,1 (minimum 1, maximum 17)
Average age female sex	8,8 (minimum 1, maximum 16)
Average hospital stay per admission (days)	14,8 (minimum 3, maximum 41)
Surgical-conservative treatment ratio	2,2 a 1 (27/12)

Source: clinical records.

The anatomical areas most affected by osteomyelitis in decreasing order were: hand, femur and distal tibia, foot, proximal tibia, calcaneus, distal humerus, clavicle, ischium, sacrum and proximal radius (Table 2).

Table 2 Anatomical localization of osteomyelitis

Zone	Frequency	Percentage
Hand	9	23,0
Distal Femur	7	17,9
Distal Tibia	6	15,3
Foot	5	12,8
Proximal Tibia	4	10,2
Calcaneus	2	5,1
Distal Humerus	2	5,1
Clavicle	1	2,5
Ischium	1	2,5
Sacrum	1	2,5
Proximal Radius	1	2,5

Source: clinical records.

In 33 patients (84.6 %) the route of arrival of the germ to the bone tissue was by hematogenous route, 4 by contiguity and 1 by direct route for 10.2 % and 2.5 % respectively.

Of the patients, 33.3 % became chronic, which is why some patients required more than one hospitalization.

The majority of patients need only one admission in 66.7% of cases, 12.8% required two admissions, 17.9% had three admissions and only one patient had four hospital admissions (Table 3).

Table 3 Number of hospital admissions and average number of days

Number of revenues related to the entity	Frequency	Percentage
One income	26	66,7
Two incomes	5	12,8
Three incomes	7	17,9
Four incomes	1	2,6

Source: clinical records.

The causal germ was isolated in 20 patients, where Staphylococcus aureus predominated in 17 patients, for 85 %. Other germs detected were: Salmonella, Enterobacter and Pseudomona, each with 1 patient.

The antimicrobials with the highest sensitivity to Staphylococcus aureus were: cefazolin, amikacin, fosfocin, meropenem, linezolid, cefepime and vancomycin.

DISCUSSION

According to Munshi,et al.[16] the most affected age group is in the range of 5 to 9 years, data that in our research coincides with that of these authors. On the other hand, Nadau,et al.[17] stated in their study an average age of 11.9 years, somewhat higher than that found in this research. When taking into account the average age of 10.2 years endorsed by Taylor,et al.[18] it is similar to that obtained by the authors of this study.

In relation to the average age, the work carried out is related to that expressed by Kyler,et al.[19] The male sex predominated in the research, which is related to that indicated by Disch,et al.[20] and Krysztofiak,et al.[21] The predominance of the male sex is related to the greater presence of trauma of the lower limbs.

Patients with this entity require prolonged administration of antimicrobials, usually for six weeks, of which two to three weeks will be by parenteral route, hence the need for prolonged hospitalization in these patients, data that are related to that reported by Disch, et al.[20] in which patients with osteomyelitis have a stay of more than 10 days and also require several admissions.

The treatment of pediatric patients with osteomyelitis is based on several pillars, among which are: general measures based on hydration and control of hyperthermia; the use of antimicrobials and the use of immobilization of the extremity to avoid secondary fracture due to weakness of the bone structures.

On the other hand, surgical modalities are justified in case of limited or no response to antimicrobial treatment, associated with worsening of symptoms and signs, both local and general, and when there is the presence of abscess demonstrable by imaging methods.[22,23,24]

Sergi,et al.[25] state that the metaphysis around the knee are the most affected by hematogenous osteomyelitis. Other authors such as Copley[26] report that the incidence of the femoral metaphysis is 27% and of the proximal tibia in 22%, these elements in which the research is in relation to what is stated by these authors.

The arrival of the germ by hematogenous route is the most common, due to anatomical conditions of the metaphysis in pediatric ages according to Copley[26] this statement is related to the research carried out when taking into account this aspect.

About one third of the patients evolve towards chronicity, especially when the location is in the metaphysis close to the knee and they are more than 10 years old. Although a certain genetic predisposition for the chronicity of osteomyelitis is currently proposed, this assertion has not been fully demonstrated according to Dabov.[27]

The germ most frequently found in cultures taken from patients with osteomyelitis is Staphylococcus aureus in more than 70% of the cases and 30% of them are resistant to methicillin according to Disch et al, [20] the research carried out coincides with the data of these authors. Other professionals such as Wen et al.[28] also affirm the higher prevalence of this germ in this infectious entity in pediatric patients.

The selection of antimicrobial therapy is empirical until the culture result is obtained, where the type of germ and its sensitivity are specified. Among the most commonly used antimicrobials in this period are: cefazolin, oxacillin, nafcillin and ceftriaxone, among others.[29,30]

The antimicrobial to be used will depend on each institution based on the results of the antibiograms, in order to suggest an effective treatment scheme. Based on the results of the investigation, we suggest the use of cefazolin, amikacin and fosfocin. In case of suspicion of the presence of methicillin-resistant staphylococcus, we recommend the administration of vancomycin or linezolid.[26,29]

According to Copley[26] the following requirements must be present for the change from systemic to oral antimicrobial therapy: clinical and hematological improvement, tolerance of the antimicrobial by the patient and availability for administration to the patient.

The main limitation of the research is that it is a local study, carried out in a single institution.

CONCLUSIONS

The results obtained in the research provide important elements from the epidemiological point of view in pediatric patients suffering from osteomyelitis, which allows the implementation of diagnostic and therapeutic strategies in this group of patients.

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