

## OSTEOMYELITIS: FROM DIAGNOSIS TO TREATMENT

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**Abstract:** This study aimed to carry out a bibliographic review about Osteomyelitis, a bone inflammation caused by an infection. Since 1984, osteomyelitis has been known, which is a bone inflammation due to a constant infection process, which occurs when a pathogen has access to the bone through an exposed wound, or resulting from trauma or a post-surgical procedure. To make the diagnosis, when the individual presents signs and symptoms (fever, chills, abscesses, edema and local erythema), which can be localized or systemic. We identified it through alterations in an X-ray exam, also requiring complementary exams. This pathology has different classifications, but with a standard initial treatment, with the use of drugs and even surgical intervention in more severe cases. The highlight is given to the group most affected by the pathology, men, whites aged over 60 years are the most seriously affected. This way, it is necessary to give due importance to carrying out more research and forms of prevention for this pathology and its consequences.

**Keywords:** Osteomyelitis, diagnosis, treatment.

## INTRODUCTION

Osteomyelitis has been present in the specialized literature since it was mentioned by Nelaton, in 1844, as an infectious inflammatory process in the bone. However, the clinical manifestation of a secretive wound after wounding is cited in history as far back as carved plaques in Sumeria. The treatment was based on keeping the wound open for the elimination of purulent secretion, with the local application of ointments and other substances (HEITZMANN et al., 2017).

Osteomyelitis is a bone infection characterized by progressive destruction of cortical bone and medullary cavity, with open fractures or major orthopedic reconstruction

procedures as its main etiology. Even with the decrease in mortality to approximately 2% currently nationwide, osteomyelitis remains a relevant disease due to its probable consequences, including bone necrosis (SANTOS et al., 2021). The diagnosis can be made by history and clinical examination, despite the current sophistication of imaging methods. Regarding symptoms, fever, chills, abscesses, edema and local erythema may occur (MAST, HORWITZ 2002). In addition to the clinic, the entire traumatological history must be investigated, surgical procedures, fractures and infections, and the physical examination is important to look for decreased pulses, perforating ulcers, cellulitis and fistulas (LAZZARINI et al., 2004). To aid in the diagnosis, some tests are requested, laboratory isolation of the agent, blood culture, C-reactive protein (CRP), blood count, erythrocyte sedimentation rate (ESR) and dosage of acid alpha-glycoprotein. Some imaging tests that can collaborate for the investigation are bone radiography, which shows changes after the 10th day of the onset of the disease, computed tomography, magnetic resonance imaging and ultrasound of the lesion. After diagnosis, disease management includes hygiene measures, wound care, antibiotic therapy depending on the suspicion of the microorganism and surgical management (CIERNY et al., 2003).

Symptoms can be localized or systemic. When it occurs locally, the main complaints of affected patients are chronic pain (80% of cases), edema, erythema and presence of abscess.

Systemically, fever may also occur (22% of cases). The most frequent sign in this pathology is the functional limitation in the affected area (SILVA et al., 2017). According to Heitzmann et al. (2017), the treatment of chronic osteomyelitis must be multiphase and basically involve three combined strategies:

1) clinical compensation of the patient; 2) drug treatment with antibiotic therapy; and 3) surgical approach. The objective of this bibliographic review was to evaluate which diagnoses are related to Osteomyelitis and the most recurrent treatments.

## METHODOLOGY

For the preparation of this study through a literature review, data were collected through the search for scientific articles in the Google Scholar, SciELO, PubMed, and ``Revista Brasileira de Ortopedia`` (R.B.O) databases. Three keywords (MeSH terms) relevant to the theme proposal were selected: "osteomyelitis", "diagnosis" and "treatment".

## RESULTS AND DISCUSSION

With the updating and evolution of osteomyelitis pathology research, it resulted in several classification systems proposed over time. Maffulli et al. (2016) state that osteomyelitis is classified into four categories: acute osteomyelitis, chronic osteomyelitis, prediabetic-related osteomyelitis, and bone implant-related osteomyelitis. However, Heitzmann et al. (2017) propose that the etiological classifications of osteomyelitis most used in the literature are that of Lew-Waldvogel (classifying into hematogenous, by contiguity and chronic) and Cierny-Mader (which takes into consideration, the pattern of bone involvement, according to the etiology and host conditions) (MAFFULI et al., 2016). Cierny and Mader (1989) and Cierny et al. (2003) take into consideration, the pattern of bone involvement according to the etiology (types 1 to 4) (Figure 2), and host conditions (types A, systemic B, local B, B both, C). This classification is intended to guide treatment decisions.

Type 1 – intramedullary, usually resulting from intramedullary pinning. Type 2 – Superficial, usually resulting from the

continuation of a pressure ulcer. Type 3 – stable permeative, in which the infection penetrates the cortical layer and enters the medullary layer, but the bone remains biomechanically stable (load bearing). It is usually observed in the infected post-operative period of osteosynthesis with plaque. Type 4 – unstable permeative, in which the infection is extensive, affects the cortical and medullary layer, and the bone is biomechanically unstable. It may occur after aggressive infection or after extensive debridement. Host A – patient and healthy limbs. Systemic B host – history of diabetes mellitus, senility, alcohol or drug use, immunodeficiencies. Host B local – previous local burn, scarring, cellulitis, previous surgery, and local vascular disease. Host B systemic and local – combines systemic and local involvement. Host C – multiple comorbidities that make the patient unable to withstand treatment. After analysis by Soares (2014), hospitalization, in 17 cases (51.5%) some surgical procedure was performed, and only in 2 (6.1%) cases there was no procedure, while in the other 15 cases (45.4%) this information was not recorded in the article. Of the 33 cases studied, *S. aureus* was isolated in 33 (100%) of the cases. Of these cases (n=33), there were 21 (63.6%) with methicillin-resistant *S. aureus* (MRSA), and only 3 (9.1%) were sensitive by the in vitro test (antibiogram) to methicillin. According to the study carried out by Luna et al. (2010), the percentage.), the percentage of methicillin-resistant *S. aureus* (63.3%) was high in this study, which may indicate an increased incidence of methicillin-resistant *S. aureus* infections in the population. In a survey carried out by the Department of Informatics of the Unified Health System (DATASUS) significant data were collected, where the largest number of patients hospitalized for osteomyelitis are elderly, among these, the highest rate is male, thus females with a lower rate of cases. In addition, it was possible to

verify that the white ethnic group has a higher prevalence in the number of reported cases.

In the present study, some risk groups were verified; among them the male gender, which is responsible for 70.87% of hospitalization cases in Brazil, being aged between 30-39 years and the Southeast region due to the high mortality rate due to osteomyelitis. During the years 2009 to 2019 there were 183,975 hospitalizations for osteomyelitis in Brazil.

The Southeast region had the highest prevalence of the number of cases (38.88%), followed by the Northeast (30.64%), South (15.01%), Midwest (8.42%) and North (7.03%). It was noted that the Southeast reached a mortality rate of 1.6 deaths per 100 hospitalized patients, followed by rates of 1.16 in the Northeast, 0.99 in the South, 0.81 in the Midwest and 0.37 in the North region. From this study it was found that in all regions analyzed and studied, males were more affected than females. The male gender is responsible for 70.87% of cases of hospitalization in Brazil for osteomyelitis, that is, a risk group was found.

Based on a study by Magajewski and Lima (2019), information from 3,783,969 hospital admissions performed by SUS in Santa Catarina in the period 2008-2016 was analyzed. Hospitalizations for osteomyelitis totaled 6,916 in the period, representing 0.18% of the total hospitalizations studied. In Table 1, it is observed that there were 118.26 hospitalizations for osteomyelitis per million inhabitants (pmp) in Santa Catarina between 2008-2016. There was an annual average reduction ( $\beta$ ) of 10.25 hospitalizations for osteomyelitis/million men and 4.80 hospitalizations/million women in the period studied (p-value = 0.03), with an overall decrease of 7.55 hospitalizations/ million inhabitants (p-value 0.04).

In a data analysis performed by Souza et al. (2019), it was found that patients aged 60 to

69 years were the ones with the highest record of hospitalizations for osteomyelitis between the years 2012 and 2016, with 8,786 cases (52.49% of the total for the elderly), followed by those aged 70 to 69 years. 79 years old, with 5,232 (31.2%), and those over 80 years old, with 2,718 (16.24%). The attendance of patients between 60 and 79 years old evolved in a similar way, with a decrease in 2013 and 2016, as well as an increase in 2014 and 2015. From 80 years old onwards, the drop-in records occurred from 2012 to 2014, with an increase in 2015 and 2016. Considering the values by region, in all the patterns Demarchi (2019) profiled 74 patients, including adults and children with septic arthritis (n=44) and osteomyelitis (n=30) treated at São Paulo hospital. Paul.

Among adults, males (55%) were more prevalent than females (45%), whereas among those under 20 years of age, there was a predominance of girls (56%) compared to the values found for boys (44%). The average age is 45 years for males and 51 years for females; mean age among children was 11 years for boys and 2 years for girls. After the finite element analysis on the subject was verified by Heitzmann et al. (2017), which were the main bacterial etiological agents present in osteomyelitis and respective antibiotics for treatment (Table 2)

Heitzmann et al. (2017) also analyzed the main antibiotics used with internal devices (surgical cement and others) for the treatment of osteomyelitis, their respective local concentration peaks in the wound and duration of the effective dose available. Gentamicin, Vancomycin, cefepime, tobramycin, meropenem were the most effective antibiotics with dosages and duration according to their effectiveness.

Antibiotic therapy aims to establish the usual infectious organisms for the clinical situation in question, select the definitive

therapy based on the results of culture and sensitivity tests (preferably bone), prescribe doses that guarantee serum levels (and therefore, bone levels) appropriate, consider parenteral therapy initially, especially for severe infection, consider oral therapy as subsequent to IV therapy or as initial therapy for less severe infection, favor agents with proven clinical effectiveness (for example: beta-lactams, clindamycin, fluoroquinolones, and rifampicin) (combined with other agents), treat residual infected bone for a minimum of 4 weeks, surgical procedures aim to drain any soft tissue or bone abscesses, perform surgery on a urgency to treat a severe infection in soft tissue (and usually not bone), try to debride any necrotic soft tissue, consider resection of necrotic bone, in most cases, determine if any type of metal device or apparatus is implanted in infected bone, which must be removed, stabilize any type of fractured or unstable bone (internally or externally), eliminate any dead space; consider the use of antibiotic-impregnated cement/beads or tissue flap placement, consider revascularization of severely ischemic tissues.

Rebuild skeleton if necessary, restore soft tissue coverage of bone when necessary with plastic surgery. Supportive measures are optimizing the patient's nutritional and metabolic condition, treating underlying disorders such as anemia, hypoxia, edema, providing psychological and social support as needed, offering rehabilitation services as needed.

Debridement is very relevant for removing necrotic tissue, as the bacteria is highly resistant. For this reason, individualized treatment is necessary, so that the most appropriate therapy for the patient is prescribed. In conjunction with this procedure, the administration of drugs (antibiotics) is indicated at the outset, due to changes in the levels of inflammatory markers of serum

C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR). According to Lipsky and Berendt (2010), in osteomyelitis, pathological bone remodeling occurs, a bone destruction that can compromise bone biomechanics. If treated incorrectly, it can develop a comorbidity of the disease. There is a difference in the development of osteomyelitis in adults and children, for the reason that in children the physis (growth plate) located between the epiphysis and the metaphysis of the bone, formed by cartilage, can be affected, and with that, septic arthritis, reaching mainly hip, elbow and ankle. This way, the authors mentioned above demonstrate that there is a difference in the development of osteomyelitis in adults and in children, for the reason that in children the physis (growth plate) located between the epiphysis and the metaphysis of the bone, formed by cartilage, can be affected, and with that get septic arthritis, affecting mainly hip, elbow and ankle. After studies by Lipsky and Berendt (2010), it was verified that the main causes of development of osteomyelitis are due to trauma (orthopedic surgery or open fracture), orthopedic prosthesis and diabetes mellitus. As secondary factors it was possible to observe that there is an intravascular catheter, hemodialysis, sickle cell anemia, spinal cord injury, peripheral vasculopathy, alcoholism, use of drugs of abuse, immunosuppression, history of tuberculosis and extremes of age.

## CONCLUSION

From the results analyzed, it is concluded that osteomyelitis is considered a relevant disease, which must be treated with intensive antibiotic therapies, surgical measures and appropriate postoperative treatments to eliminate the infection, effectively, so as not to worsen and lead to bigger problems. A set of exams is necessary to identify it, with the main one being the image, where changes are visible.

The elderly age group is the target audience most affected by this disease. This way, one must always pay attention to the complaints

that the elderly makes, especially when it comes to abscesses, receive them properly and treat the whole situation so that it does not evolve into a more severe pathology.

A treatment plan containing the initial complaints and palliative care is considered extremely necessary, as they will define whether the healing process will be short or long term, depending on which category they are in and whether the patient has any type of comorbidity. It must be noted that osteomyelitis needs further studies, mainly in the area of physiotherapy, as it is linked to other degenerative pathologies of movement.

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