

**CAUSES OF ACUTE HEMATOGENOUS EPIPHYSEAL  
OSTEOMYELITIS IN INFANTS (LITERATURE REVIEW)**

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**ABSTRACT**

*The review article analyzes the literature reflecting the current views of acute hematogenous epiphyseal osteomyelitis in children, as well as the methods of diagnosis and treatment of the disease proposed by various authors. The modern problem of acute hematogenous osteomyelitis in young children is due to the severity the course of this purulent-septic pathology, with the continuing difficulty of early diagnosis, unsatisfactory results of treatment. The study of the literature showed that the issues of the pathogenesis of the disease have been studied quite well, however, the methods of examination and surgical treatment proposed by the authors are still controversial. Based on the analysis of literature data and the results of our own research, the main etiological factors and risk factors that determine and predetermine the complex of local destructive and systemic metabolic disorders in OA in young children are presented.*

**KEYWORDS:** *Acute Hematogenous Epiphyseal Osteomyelitis, Purulent-Sepsis, Children.*

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**INTRODUCTION**

Acute hematogenous epiphyseal osteomyelitis ranges from 3.4 to 47% among severe purulent-septic infections. The disease that arose in early childhood due to the subsequent development of orthopedic complications (31-71%) is accompanied by frequent disability. The modern problem of acute hematogenous osteomyelitis in children is due to the high incidence of the child population and the severity of this purulent-septic pathology in childhood, with the continuing

difficulty of early diagnosis, unsatisfactory treatment results with frequent chronicity of the purulent process.

Despite the progress made in the treatment of Acute hematogenous epiphyseal osteomyelitis in children, mortality in severe forms of the disease ranges from 0.2 to 3.7%, and the transition of the disease to the chronic stage is from 5.2% to 13.0%. After undergoing epiphyseal osteomyelitis, orthopedic complications occur in 23–58.3% of patients [3; 4]. This disease is closely related to social and economic factors; therefore, over the past decade, the pathomorphosis of the disease has been clearly traced [1; 4; 5]. At the present stage, the organization of medical care for patients with this serious disease remains imperfect. In 77.0–86.2% of cases, late hospitalization of patients is noted. The level of timely diagnosis before hospitalization remains low, and there is a misunderstanding of the urgency of providing urgent care for this pathology. Diagnostic errors during the initial examination of the patient are observed in 25.1–58.3% of cases.

**Objective:** to systematize foreign and domestic literature on acute epiphyseal hematogenous osteomyelitis

The incidence of hematogenous osteomyelitis in the age aspect according to different authors the femur and tibia are affected (80%) [3;7;8]. Localization of acute hematogenous osteomyelitis in metaepiphyses occurs more often at an early age [11]. In 30.5% of newborns with acute hematogenous osteomyelitis, there is a lesion of the epiphyses [10]. With the development of bacterial sepsis in the clinical course of acute hematogenous osteomyelitis in a patient, the danger to his life is determined by the severe course of the disease and the low effectiveness of traditional treatment of children, with a dangerous outcome in multiple organ failure and mortality [14]. H. has contributed quite a lot to the doctrine of sepsis .Schottmuller, who created a theory about the significance of the primary purulent focus, from which microbes penetrate into the blood through the vascular system. He believed that the course of the septic process depends both on the number of microbes entering the bloodstream and on the volume of tissues and organs covered by the inflammatory process.

Currently, one of the urgent problems in emergency neonatal surgery is the early diagnosis and adequate treatment of infectious complications. In this regard, difficulties are associated with the fact that the recommended modern definitions of septic conditions differ from the terminology used by most neonatologists [11;18]. In addition, there are differences in pathophysiology, clinical interpretation of infection and susceptibility of newborns to the same bacterial pathogen depending on gestational age. Intrauterine infection is of great importance in the development of many pathological conditions of the gestational period, diseases of childhood and later stages of human life and is an urgent problem of perinatology [15; 17;19].

According to some authors, the most successful definition of sepsis is: sepsis is a generalized, polyethological infectious disease with an acyclic course, with the presence of a primary purulent-inflammatory focus, the occurrence and course of which is determined by the characteristics of the macroorganism and the properties of the pathogen. Endogenous foci of infection and the general somatic condition of the patient play an important role in the development of the disease, forming a decrease in the immunological resistance of the body, which in turn leads to the ineffectiveness of surgical and antibacterial treatment and the occurrence of a relapse of the bone-purulent process [7; 13]. The study of the etiopathogenesis of

sepsis and the peculiarities of its clinical course in children of different age groups remains relevant from the standpoint of the immune status [17]. The systemic response to infections is the result of an imbalance in the interaction of pro- and anti-inflammatory reactions of the body, initiated by endo- and exotoxins of bacteria, and mediators formed in the area of tissue damage.

The relationship between the virulence of pathogenic staphylococci and the severity of the course of staphylococcal infection was studied. N.V.Beloborodova noted that highly virulent strains always gave a severe course of the disease. An important etiological factor of acute hematogenous osteomyelitis in children in 40-50% of cases may be viral infections, against which the disease develops. Viruses suppress the body's defenses and contribute to the virulence of microorganisms. The causative agents of acute hematogenic osteomyelitis in children can be various microorganisms: aerobes (*Staphylococcus aureus*, hemolytic streptococcus, etc.), anaerobes, viruses. Analysis of the literature data indicates that the main causative agent of this disease is *Staphylococcus aureus* [6]. Gram-negative flora (*Pseudomonas aeruginosa*, proteus, salmonella, etc.) plays an important role in the etiology of disseminated forms of acute hematogenous osteomyelitis, accompanied by the development of a systemic reaction of the body, the detection frequency of which is 25.9%. According to various authors, newborns in 100% of cases are affected by *Staphylococcus aureus* by the end of the first week of life, and in the intestines of children it persists for up to one year. Pyoderma, vesicopustulosis, pemphigus, pseudotuberculosis, mastitis, paraproctitis, lymphadenitis, pneumonia and other diseases of staphylococcal etiology can contribute to the development of acute hematogenic osteomyelitis [2; 9].

Thus, most often (from 64.2 to 89.2%) the causative agent of infection is pathogenic staphylococcus. N.S. Strelkov believes that under the influence of various conditions, including the powerful effects of antibiotics, there is a change in the species composition of pathogens of acute hematogenic osteomyelitis, but, as before, *Staphylococcus aureus* is in the lead - from 88% to 95% of observations. Among the etiological factors, the role of streptococci increased to 5%. However, according to the results of research by A.M.Shamsiev et al., 123 newborns with acute hematogenous metaepiphyseal osteomyelitis, 64.4% were seeded with gram-negative flora. To date, many authors adhere to a single classification of gram-negative non-spore-forming microorganisms that cause septic shock, among which bacteria (cocci) are isolated. Underestimation of the role of anaerobes led to errors in the diagnosis of septic osteomyelitis and gave rise to a large group of unregistered infections with a severe clinical course [12]. Recent studies have shown that the most significant category for the development of septic osteomyelitis in children is mixed anaerobic or anaerobic – aerobic infections that occur with the participation of non-spore-forming bacteria.

Currently, medical practice has a huge arsenal of therapeutic agents and techniques that allow to influence almost all links in the pathogenesis of the purulent-septic process. Continuous improvement of surgical methods of influencing the purulent focus, the emergence of new generation antibacterial drugs and a variety of immunotropic agents, the use of new methods of combating toxicosis, in particular extracorporeal detoxification, have significantly improved the results of treatment of hematogenous osteomyelitis. A wide variety of therapeutic techniques makes it possible to solve one practical problem in different ways. But at the same time there are certain difficulties associated with the need to select the most optimal therapeutic measures for a specific infectious process. Therefore, the results of treatment of children with severe forms of

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hematogenous osteomyelitis depend not only on the development and introduction of new therapeutic techniques, but also on a clear pathogenetic justification for the use of certain treatment methods [9; 16].

Intrauterine infection is one of the causes of perinatal development of acute hematogenous osteomyelitis in children under three months of age, generalization of the inflammatory process and fatal outcomes [7]. The infectious process, which began in utero, causes a different response from the postnatal period of the body's immune system, characterized by a peculiar clinical picture of the disease and low sensitivity to standard treatment methods [2]. Inflammatory diseases of the osteoarticular system belong to one of the severe pathologies of the newborn period. Embolic theory does not fully explain the sudden onset of primary acute hematogenous osteomyelitis, which developed without any previous inflammatory disease, against the background of complete health. The neuro-reflex theory was widely recognized in the middle of the XX century, according to which pathological irradiation from the focus of the inflammatory process is associated with a sharp irritation of the interoreceptor apparatus of the bone and its reflex effect on the state of the central nervous system and the cardiovascular system. At the same time, the active beginning of pathological osteoreception is a sharp increase in intraosseous pressure caused by various reasons. This theory is important in explaining the appearance of a pathological process in the bone, in understanding the development of a number of pathological reactions on the part of vital organs. Neurogenic disorders are based on the formation of pathologically enhanced excitation generators.

The effects that cause the formation of pathologically enhanced excitation generators include physical and chemical factors, scar deformations, as well as a cascade of phospholipid hydrolysis enzymes, excessive formation of arachidonic acid and its metabolites. These processes are activated in conditions of thrombosis, bone ischemia in the dynamics of the development of acute hematogenous osteomyelitis. In addition, endogenous biologically active substances contribute to the emergence of pathologically enhanced excitation generators: prooxidants, hydroperoxides, phospholipase hydrolysis products, enhanced lipid peroxidation, nitric oxide [8;13]. Osteomyelitis, which developed in the fetal period, is a little-known disease and belongs to rare observations [18]. In recent years, there has been an increase in the number of patients in the surgical hospital due to premature, underweight patients who, due to anatomical, physiological, immunological, microbiological features, are more susceptible to purulent-septic diseases [1; 2].

In an experiment on a model of gram-negative sepsis, it was proved that at the initial stages of septic shock, the phagocytosis system, 21 immunoglobulins and B-lymphocytes play the greatest role; at a later date, all complexes of T-lymphocytes and factors of a specific immune response (complementary and proportional system, cytotoxic activity of blood, etc.) are included. According to N.T. Dolidze et al.; N.I. Melnikova et al.; Duke, D.; Cardinal, E. et. al. Studies of sepsis have led to some success in understanding the pathogenesis of the disease, especially caused by gram-negative flora. The central link of pathogenesis is a part of the shell of gram-negative bacteria, which is called endotoxin or lip polysaccharide - both of these names are used synonymously. The level of endotoxin can be determined in the blood serum qualitatively and quantitatively using a highly specific test. Clinical studies indicate an important prognostic role of the determination of endotoxin in the blood serum of patients before the start of antibacterial therapy. These studies revealed a direct correlation between the level of endotoxin, the severity

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of multiple organ failure and an unfavorable outcome in patients with generalized infections. However, the use of this method for determining the severity and prognosis of gram-negative sepsis in normal clinical practice is not possible due to the high cost and technological complexity [5]. According to the data, the number of affected organs and systems is essential for the clinical picture of septic shock development, which allows us to characterize the prognosis quite definitely: for example, in case of insufficiency of one organ or system (I-degree shock), lethality is 30-40%, two (II-degree shock) – 50-60%, three and more (III-degree shock) - 80 – 90%. The degree of organ function reduction in septic shock determines the strategic approach to the correction of disorders – the choice of methods of correction of nervous, coagulationolytic, metabolic and other internal reserves or temporary replacement of the function of the lost organ by artificial methods [6]. Among the causes directly leading to the development of postoperative osteomyelitis, the authors distinguish: organizational, tactical, technical, sanitary-epidemiological and somatic causes [9]. One of the characteristic features of chronic osteomyelitis is a prolonged, lasting for years course of the disease. A long purulent process, such as chronic osteomyelitis, disrupts the metabolism, the function of the liver, kidneys and reticuloendothelial system. One of the most common and severe consequences of chronic purulent infection is a myeloidosis of internal organs [3;8].

According to the modern concept of the development of purulent surgical infection of childhood, the occurrence and progression of acute hematogenous osteomyelitis in younger children is determined not only by the factors of aggressiveness of the pathogenic agent, but also by the state of the mechanisms of specific and nonspecific resistance. An objective judgment about the state of the protective forces of the child's body is based on a clinical and laboratory analysis, including a comparison of the clinical symptoms of the disease with the results of various studies. As noted by A.A. Baskov et al., T.A. Vasina et al., N.V. Beloborodova, Macionis, V. et.al., Liu, H. et.al suppuration of soft tissues in children is characterized by a slight decrease in factors of nonspecific reactivity and cellular immunity, while humoral immunity remains intact and is even somewhat stimulated, as evidenced by an increase in immunoglobulin levels due to antigenic irritation by microorganisms.

## CONCLUSIONS:

Thus, the analysis of literature data and the results of our own research indicate that the main etiological factors and risk factors that cause and predetermine the complex of local destructive and systemic metabolic disorders in acute hematogenous osteomyelitis in young children are:

1. Cytotoxic effect of infectious pathogens on the child's body, pathogenicity factors and toxins produced by them in the inoculation zone.
2. The absence or insufficiency of normal microflora in the child at the time of infection, ensuring the suppression of a pathogenic competitive strain of the pathogen.
3. Unfavorable premorbid background (presence of foci of purulent infection in the mother, complicated course of pregnancy and childbirth, accompanied by blood loss, trauma, infection of the fetus).
4. Insufficiency of specific immunological defense mechanisms in the form of congenital or acquired immunodeficiency in T-, B-lymphocyte systems, or a combined form of immunopathology.

6. Insufficiency of nonspecific resistance factors.

7. Insufficiency of mechanisms for the formation of typical pathological processes, in particular inflammation, providing encapsulation and inactivation of infectious pathogenic factors in foci of infection.

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