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# Description of the Microbial Landscape of Causative Agents of Acute Osteomyelitis Observed in Children

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**Annotation:** The purpose of the study was to determine the dependence of microbiological aspects of the formation of acute osteomyelitis from childhood and compare the results.

**Materials and methods:** methods for the analysis of biological materials (blood and pus) taken from 68 children diagnosed with acute osteomyelitis using bacteriological, bacterioscopic and statistical research methods.

**Obtained results:** The features of microbiological aspects and the results of the influence of microbial pathogens in children with acute osteomyelitis in the dynamics of the pathological process in accordance with the age state of children are presented.

**Conclusion:** Based on the study and analysis of the main microorganisms from biological materials taken from children with acute osteomyelitis, the importance of the role of macro and microorganisms in the formation of acute osteomyelitis in children, comparative analyzes of etiological agents, indicators of change, as well as the results are presented.

**Keywords:** pus, pathogens, strain, monoculture, association of microorganisms, identification, osteomyelitis.

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## Relevance of the problem

As a result of the impact of various internal and external negative influences on the human body, when the protective factors of the body decrease, this pathology is characterized by frequent occurrence, severe course and complications [7, 8, 14].

23-58.3% of patients with metaepiphyseal osteomyelitis had orthopedic complications. In addition, the development of osteomyelitis was detected in 1.6-22.4% of patients after operations on the musculoskeletal system [3].

The etiological agents of osteomyelitis are microorganisms of various genera and species, including gram-positive cocci, gram-negative bacteria, anaerobes, as well as various microscopic fungi [4, 6, 10, 12].

The development of osteomyelitis was detected in 1.6-22.4% of patients after operations on the musculoskeletal system [3]. Metaepiphyseal osteomyelitis in 23 - 58.3% of patients had orthopedic complications.

According to information obtained from scientific sources, the microflora of the focus of osteomyelitis is represented by aerobes by 67.5%, anaerobes by 31.5%, microscopic fungi by 2% and in most cases occurs in the form of associations of microorganisms consisting of 2 and 3 pathogens. Dependence of the spectrum of etiological agents on the onset of the disease, its stages, the duration of the persistence of the pathological process in the bone and treatment tactics [1, 9, 11].

Although a lot of practical and fundamental research has been carried out on the distribution, classification, pathogenesis, clinic, treatment and prevention of osteomyelitis [2, 4, 5, 13], microbiological aspects of these diseases, the degree of occurrence of etiological agents in various forms, the exchange of triggers in the body, the dynamics of the course, the course of the pathological process from acute to chronic course. In the past, aspects of the microorganism and the creation of criteria that determine the prognosis of the disease have not been sufficiently studied. [16,17].

### Research results and discussion

Bacteriological examination of biological materials taken from 68 children with osteomyelitis revealed 78 strains. Their germination percentage was in the case of monoculture (53.9±5.6%, n=42) and M/a (46.2±5.6%, n=36). *S. aureus* leads in monoculture (19.2±4.5%, n=15), followed by non-fermenting gram-negative bacteria (NFGN) - *P. aeruginosa* (11.5±3.6%, n=9). [15]

*E.coli* (7.7±3.0%, n=6) and *S. epidermidis* (5.1±2.5%, n=4), other gram-negative and gram-positive microorganisms, anaerobes were identified as pathogens in certain quantities, and causative agents pathogens such as microscopic fungi are identified as etiological agents in small quantities in the form of a monoculture and do not play an important role in the etiological structure of osteomyelitis in the studied children. Indicators of pathogens from biological materials taken from children with osteomyelitis included in the study 1.1 are given in the table.

**Table 1.1 Indicators of pathogens from children with osteomyelitis, n=68**

Etiological agent	A/M		Monoculture		Total	
	AN	%	AN	%	AN	%
<i>E.coli</i>	5	6,4±2,8 ↔	6	7,7±3,0	11	14,1±3,5
<i>Proteus spp</i>	4	5,1±2,5 ↔	2	2,6±1,8	6	7,7±3,0
<i>Klebsiella spp</i>	2	2,6±1,8 ↔	3	3,8±4,7	5	6,4±2,8
<i>Enterobacter spp</i>	2	2,6±1,8* ↑	0	0	2	2,6±1,8
<i>P. aeruginosa</i>	2	2,6±1,8* ↓	9	11,5±3,6	11	14,1±3,5
Gram-negative bacteria, total	15	19,3±4,5 ↔	20	25,6±4,9	35	44,9±5,6
<i>S. aureus</i>	10	12,8±3,8 ↔	15	19,2±4,5	25	32,0±5,3
<i>S. epidermidis</i>	8	10,3±3,4 ↔	4	5,1±2,5	12	15,4±4,1
<i>S. saprophyticus</i>	1	1,3±1,2 ↔	1	1,3±1,2	2	2,6±1,8
<i>E. faecalis</i>	0	0 ↔	2	2,6±1,8	2	2,6±1,8
Gram-positive cocci, total	19	24,4±4,9 ↔	22	28,2±5,1	41	52,6±5,7
<i>Candida spp</i>	2	2,6±1,8* ↑	0	0	2	2,6±1,8
Total Strains	36	46,2±5,6 ↔	42	53,9±5,6	78	100,0

Note: A/M - association of microorganisms; AN is an absolute number; ↔ - no differences, ↑, ↓ - significantly increased or decreased compared to monoculture; all percentages were calculated based on the total number of strains (n=78).

Gram-positive cocci (*S. aureus* 12.8±3.8%, n=10 and *S. epidermidis* 10.3±3.4%, n=8) are the leading places in the association of microorganisms, according to the information provided in scientific sources and their meeting according to the trend. However, there was no reliable difference between gram-positive and gram-negative microorganisms due to the wide spectrum of germination in gram-negative bacteria.

30 strains with 2 microorganisms, 6 strains with 3 microorganisms were found in 26 patients with osteomyelitis as follows:

- 2 microorganisms: *S. aureus* and *E. coli* - 3; *S. epidermidis* and *P. aeruginosa* - 2; *S. aureus* and *Proteus spp* - 2; *S. epidermidis* and *Proteus spp* - 2; *S. aureus* and *S.*

epidermidis - 1; *S. aureus* and *Klebsiella* spp - 1; *S. epidermidis* and *E.coli* - 1; *S. aureus* and *Enterobacter* spp - 1; *E.coli* *Enterobacter* spp - 1; *S. epidermidis* and *Klebsiella* spp - 1 time.

- 3 microorganisms: *S. aureus*, *S. epidermidis* and *Candida* spp - 1; *S. aureus*, *S. saprophyticus* and *Candida* spp - 1 time.

No significant differences were found between monoculture and A/M encounter rates. Similar results were observed among gram-positive cocci and gram-negative bacteria. It is noteworthy that *S. aureus* is the leader in monoculture, followed by *P. aeruginosa*. *E.coli* and *S. epidermidis* were identified as causative agents in certain quantities, while other causative agents were found in small amounts. Gram-positive cocci (*S. aureus* and *S. epidermidis*) took the leading place in the association of microorganisms, corresponding to the general trend of meeting the causative agents according to the literature data on osteomyelitis.

Spectrum of causative agents in the acute form of the disease (table 1.2. strains belonging to 4 types)

**Table 1.2 Distribution of etiological agents in children with osteomyelitis according to the manifestations of the disease**

Pathogens	Acute phase, n=23	
	AN	%
<i>S.aureus</i>	14	18,0±4,4
<i>S.epidermidis</i>	3	3,8±4,7
Gram-positive cocci, total	17	21,8±4,7
<i>E.coli</i>	3	3,8±4,7
<i>Proteus</i> spp	2	2,6±1,8
Gram-negative bacteria, total	5	6,4±2,8
Total Strains	22	28,2±5,1
No growth	1	

Note: all percentages were calculated based on the total number of strains (n=23).

Also, *S. aureus* (18.0±4.4%, n=14) was the single leader in the acute form of osteomyelitis. *S. aureus* accounted for 63.6±10.2% of all strains (14 out of 22 strains) in acute form.

It is noteworthy that the main causative agents of acute osteomyelitis are gram-positive cocci (mainly *S. aureus*), while gram-negative bacteria and microscopic fungi have a low role as causative agents.

The following results were obtained when the microbial landscape of the causative agents of acute osteomyelitis observed in children was analyzed:

In acute osteomyelitis, a negative bacteriological result was observed in 6.2% of the bacteriological studies, in 93.8% of the causative agents, they were representatives of 13 genera and species. In total, 56.6% of cases were monoculture, 43.4% of cases were found as associations. Our results regarding the percentages of aerobes and anaerobes were different from the literature data, this situation was evaluated as a characteristic of the region;

In half (48.3%) of acute osteomyelitis, *S. aureus* was recognized as an etiological agent, and gram-positive cocci were reliably detected. This is due to the high number of gram-positive cocci in the acute form;

In acute osteomyelitis, *S. aureus* accounted for 51.9% of all strains, while other pathogens - *S. epidermidis*, *E. coli*, *Proteus* spp, *S. pyogenes* - did not reveal such a convincing difference.

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