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Study of Biochemical Characteristics of Antibiotic-Resistant and Sensitive Bacteria Isolated from Children

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Abstract
The article presents the results of a study of the antibiotic resistance of bacteria isolated from different patients. A comparative study of the biochemical properties of resistant and non-resistant bacteria was carried out. The results obtained indicate the activity of certain biochemical properties of resistant bacteria, which makes it possible to formulate a hypothesis about a possible relationship between the mechanism of antibiotic resistance and the biochemical characteristics of bacteria.

Keywords: biochemical properties, antibiotic resistance of bacteria

Introduction

According to the World Health Organization, infections caused by multidrug-resistant bacteria kill 700,000 people each year, including about 200,000 newborn babies. In Europe, infections caused by polyresistant bacteria account for 30% of all cases (Luyt et al., 2014; Naylor et al., 2018). Resistant bacteria were found in 90% of newborns with sepsis admitted to intensive care units in the Middle East region; E. coli resistant to first-line antibiotics was found in 83% of children in some areas of Southeast Asia; Antibiotic-resistant bacteria have been identified in 66% of cases of neonatal sepsis and meningitis in sub-Saharan Africa (Okomo et al., 2019).
The issue of distinguishing antibiotic-resistant strains from sensitive strains by other characteristics is also an aspect on the agenda. A number of scientists associate the issue of bacteria gaining resistance to antibiotics with their living in stressful conditions and prove that there is a correlation between the change in the properties

of microorganisms in that situation and the acquired resistance (Babyak & Polina, 2017; Hawkey & Jones, 2009; Wellcome Trust, 2016).
Scientific studies conducted by a number of scientists show that the role of bacterial enzymes belonging to different classes in the formation of resistance is great. It is known that in addition to the enzymes responsible for the synthesis of the structural elements of the bacterial cell, the enzymes that catalyze metabolic processes are also involved in the formation of resistance (Roberts et al., 2013; Srinivas et al., 2009; Tassoni et al., 2017; Yegorov et al., 2018).
In the present study, some biochemical characteristics of resistant and sensitive bacterial strains isolated from children under 6 years of age at Bonadea Hospital were studied.

Materials and methods

From December 2022 to February 2023, 14 children were bacteriologically examined at Bonadea Hospital. Identification of pathogens was carried out with automated microbiological analyzer Vitek2 and mass spectrometry microbiological identification system Vitek Ms. Biochemical properties were determined through API tests.

Results and discussion

In 3 of the examined patients *Klebsiella pneumonia* (in the blood), *Serratia marcescens* (in the blood), and *Acinetobacter baumanii* (in the bronchoalveolar aspirate) were detected.
All identified microorganisms were tested for sensitivity to the following antibiotics:
Amikacin, imipenem, amoxicillin/clavulanic acid, ertapenem, ampicillin, levofloxacin, cefepıme, meropenem, cefixime, piperacıllin, ceftazidime, piperacillin/tazobactam, ceftriaxone, cefuroxime, gentamicin, cefuroxime, axetil, ciprofloxacin.

In other 9 patients, Kl. has varying degrees of sensitivity to different antibiotics. pneumonia, *E.coli*, Ps.aeuriginosa, S.enterica, St.hominis were detected. So, showing resistance to the above-mentioned antibiotics Kl. pneumonia and *E.coli* strains have higher catalase activity than susceptible bacteria. Enterococcus faecalis and *E.coli* detected in two children (4 and 6 years old) showed high sensitivity to all antibiotics.

Table 1. Biochemical characteristics of resistant strains

Type of bacteria	catalase	H_2S	urease	indole	glucose	mannose	sorbitol	arabinose
K.pneumoniae	+	-	+	-	+	+	+	+
K.pneumoniae	+	-	+	-	+	+	+	+
K.pneumoniae	+	-	+	-	+	+	+	+

P.aeuriginosa	+	-	+	-	+	+	+	+
S.marrescens	+	-	+	-	+	+	+	-
E.coli	+	-	-	+	+	-	+	+
A.baumannii	+	-	-	-	-	-	-	-
S.enterica	+	-	-	-	+	+	+	+
E.coli	+	-	-	+	+	-	+	+
E.coli	+	-	-	+	+	-	+	+

The resistant bacteria detected in the study belonged to the species included in the list of resistant bacteria considered dangerous for the human body published by the WHO in 2017 (https: www.who.int/ru).

Currently, Kl.pneumoniae among opportunistic microorganisms is distinguished by the largest number of resistance determinants, which, according to some authors, is often combined with virulence genes and the hypermucoid type of strains (Anganova et al., 2017).

Catalase enzyme was detected in all resistant strains of *E.coli* bacteria studied (table 1).

The activity of glucose, mannose, sorbitol and arabinose enzymes was related to the species characteristics in the studied strains (Table 2).

Table 2. Biochemical characteristics of non-resistant strains

Type of bacteria	catalase	H_2S	urease	indole	glucose	mannose	sorbitol	Arabi-nose
E.coli	+	-	-	-	+	+	+	+
E.faecalis	-	-	-	-	+	+	+	-
St.hominis	+	+	+	-	+	-	-	-
K.pneumoniae	+	-	+	-	+	+	+	-

It is known that the effect of antibiotics on bacteria stimulates the formation of stress conditions and, accordingly, the formation of adaptive processes in bacteria.

Studies conducted by a number of scientists have shown that certain changes occur in the biochemical properties of bacteria in the state of stress. Functional changes are also noted in bacteria exposed to antibiotics according to stress conditions. An increase in catalase activity is observed in bacteria under stress, especially exposed to active forms of oxygen. In our study, antibiotic-resistant bacteria (*E.coli* and Kl. pneumonia) showed higher biochemical activity (catalase activity) (table 1) (Antunes, 2000; Gogoleva et al., 2012; Hernandez, 2012). In the non-resistant *E.coli* strains, the indole production characteristic of this species was not noted.

Changes in the biochemical characteristics typical for a certain bacterial species are explained by the reconstruction mechanisms that occur within the population under the influence of various factors.

Conclusion

Thus, as a result of the current study, it was noted that some biochemical characteristics of resistant strains are more active than sensitive strains, and it provides grounds for putting forward a certain opinion about the existence of a relationship with the mechanism of antibiotic resistance formation.
Proving the validity of this hypothesis requires more extensive research.

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