OCCURRENCE OF *A. BAUMANNII, P. AERUGINOSA* AND SENSITIVITY TO ANTIBIOTICS IN PATIENTS AT A TERTIARY BURN CENTER IN 2015 – 2020

Výskyt *A. baumannii, P. aeruginosa* a citlivosť na antibiotiká u pacientov v terciárnom popáleninovom centre v rokoch 2015 – 2020

Vasyl NAGAICHUK[1,2], Halyna NAZARCHUK[1], Nataliia BAHNIUK[1], Roman CHORNOPYSCHUK[1], Oleksandr NAZARCHUK[1], Vira BEBYK[1], Oksana TURZHANSKA[3]

[1]National Pirogov Memorial Medical University, Vinnytsya, Ukraine, head academician prof. V.M. Moroz, PhD., Sc.D.
[2]Tertiary Clinical Center for Thermal Injury and Plastic Surgery of the MNPE, Vinnytsya Regional Clinical Hospital Vinnytsya, Ukraine, head prof. V. Nagaichuk, MD., PhD.
[3]Department of Mathematics and Informatics, Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, Ukraine, head prof. M. Kovtoniuk, DrSc.

Abstract
Introduction: Burn injuries are one of the most common traumatic injuries in the world. The leading cause of burn patients' death is infection (76.3 %).
Aim: To establish the analytical pattern of sensitivity to antibiotics of infectious agents that predominate in patients with severe burns during treatment in the burn center of a tertiary care facility.
Materials and methods: We´ve established the analytical pattern of sensitivity to antibiotics of microorganisms (*A. baumannii, P. aeruginosa*, n = 1227) predominating in patients (n = 624) with severe burns (IIb – III degree, burn area 30.0–85.0 % of body surface) during treatment in the burn center of a tertiary care facility in 2015 – 2020. Statistical processing of research results was performed using standard programs "Microsoft Excel 2010", "Statistica 12.0".
Results: *P. aeruginosa* have the highest incidence at 2 weeks of treatment with a gradual decrease over 3 – 4 weeks. According to Shapiro – Wilk´s W test (= 0.96; p > 0.05) – the amount of *P. aeruginosa* isolated from patients with severe burns over the years of research is distributed according to the normal law.
A. baumannii have the highest incidence in the period of hospitalization and 1 week of treatment with a gradual decrease at 2 – 4 weeks. According to the Chi-square test (= 0.91; p > 0.05), the number of *A. baumannii* is distributed exponentially.
Multidimensional statistical analysis of hierarchical clustering method allowed to establish the distribution of antibiotics in clusters according to the degree of *A. baumannii, P. aeruginosa* sensitivity to them.
Conclusions: *P. aeruginosa* showed the greatest sensitivity to imipenem, meropenem, amikacin, were least sensitive to amoxicillin-clavulanate, aztreonam, pefloxacin, norfloxacin. *A. baumannii* were the most sensitive to polymyxin, cefoperazone-sulbactam, doxycycline, tobramycin, ampicillin-sulbactam (Fig. 6, Ref. 28). *Text in PDF www.lekarsky.herba.sk.*
KEY WORDS: *A. baumannii, P. aeruginosa*, antibiotics, burns, infection.
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Introduction

Burn injuries are one of the most common traumatic injuries in the world. In Ukraine, about 100,000 people suffer from burns every year. In the United States, nearly 2 million people receive burns each year, about 100,000 need to be hospitalized, and about 5,000 are fatal (20).

In the cases of large and deep burns there is a number of pathological processes which create additional conditions for development of infectious process and its generalization (5, 16, 18, 23). The area of damaged skin becomes the gateway to microbial colonization and invasion. In addition to the loss of protective cover, there is a disintegration of the most important neurotrophic and metabolic functions of the body, which leads to a violation of anti-infective factors. According to scientists, the most common cause of death of the patients with burns is infection, which accounts for 76,3% of the mortality structure (4). Necrotic tissue, which is formed in the area of the burn, is a favorable environment for the invasion and reproduction of microorganisms.

Any severity of burns creates the conditions for the development and generalization of wound infection. Bacterial infections are known to be one of the leading causes of death during burn injuries (17). The causative agents of infections in critically ill patients with burns are gram-positive and gram-negative microorganisms. In modern conditions, infectious complications in patients with burns are associated with opportunistic pathogens that have become resistant to a wide range of antimicrobial agents. The ability to develop resistance to antimicrobials is one of the leading properties of infectious complications. The high adaptability of pathogens to survival in the context of widespread use of antibiotics has led to a decrease in the effectiveness of antibacterial therapy, which significantly narrowed the possibilities in the fight against resistant isolates of microorganisms. The consequences of burns lead to the occurrence of both acute and chronic pain. These consequences are very difficult to deal with (6). During the COVID-19 pandemic, complications in such patients can be even more serious – patients usually need not only adequate treatment, but also mechanical ventilation (7 – 9, 13). Such patients are usually immunocompromised. Patients with COVID-19 disease were not included in our study.

The study of the qualitative composition and sensitivity to antibiotics of microorganisms, which predominate in the structure of pathogens of infectious complications in burns, remains relevant.

The aim is to establish the analytical pattern of sensitivity to antibiotics of infectious agents that predominate in patients with severe burns during treatment in the burn center of a tertiary care facility.

Materials and methods

The study covered patients who were treated in the burn department of Vinnytsya Regional Clinical Hospital named after M.I. Pirogov (n = 624) in 2015 – 2020. Clinical isolates of *A. baumannii, P. aeruginosa* were isolated from patients with burns IIb – III degree (burn area 30.0 – 85.0 % of body surface) before antibacterial therapy, on the 7th, 14th, 21st and 28th day of treatment. Patients who were enrolled in the study underwent surgical treatment (early necrectomy in the first three days, xenodermoplasty), comprehensive general (balanced infusion-transfusion, antibacterial, symptomatic therapy) and local treatment in the required amount according to the treatment protocols of such patients. Microbiological study of biological material obtained from patients was performed in the research bacteriological laboratory of the Department of Microbiology of National Pirogov Memorial Medical University, Vinnytsya, certified by the Ministry of Health of Ukraine (Certificate of re-certification No. 049/15 dated 02.02.2021).

The susceptibility of clinical strains of *A. baumannii* was determined to the following antibiotics: ampicillin-sulbactam, amoxicillin-clavulanate, piperacillin-tazobactam, cefoperazone-sulbactam, meropenem, imipenem. The sensitivity of clinical strains of *P. aeruginosa* was determined to the following antibiotics: piperacillin-tazobactam, ceftazidime, cefoperazone-sulbactam, cefepime, imipenem, meropenem, gentamicin, tobramycin, amikacin, doxycycline, aztreonamu, norfloxacin, ofloxacin, pefloksatsina, ciprofloxacin, levofloxacin, gatifloxacin, moxifloxacin. The study of susceptibility of *A. baumannii and P. aeruginosa* to antibiotics was performed by qualitative disco-diffusion and quantitative methods of double serial dilutions (order of the Ministry of Health of Ukraine No. 167 of 05.04.2007 "On approval of guidelines for determining the sensitivity of microorganisms to antibacterial drugs"). The analysis of antibiotic susceptibility of *A.baumannii* was guided by the recommendations of the European Committee for the Study of Antimicrobial Susceptibility (EUCAST Expert rules) (1, 3, 14, 15).

Analysis of the etiological structure of pathogens of infectious complications was performed using statistical processing of numerical data obtained from burn samples of opportunistic pathogens. Arithmetic mean, mode, median, standard deviation, arithmetic mean error were determined. Data distribution was assessed by determining the coefficients of asymmetry and excess. The difference in the number of isolated bacterial isolates was determined using Friedman analysis of variance. Graphical interpretation for each time interval was used to evaluate the results of the study on the nature of the dynamics of pathogen isolation. The laws of data distribution were established on the basis of generalized results of dynamics with subsequent visual analysis (22, 25, 27).

The analysis of the results of the study of the susceptibility of clinical strains of *A. baumannii, P. aeruginosa* to antibacterial drugs was performed using statistical methods, which allowed to establish a regular relationship between the numerical values of variable traits and the probability of these values in the mass of observations. Mathematical analysis of the results of determining the sensitivity of bacteria to antimicrobial drugs using the method of hierarchical cluster analysis was used to classify antimicrobial drugs according to the degree of sensitivity. Euclidean distance, the complete linkage strategy, was used to build the dendrogram (tree clustering). As the distance between objects, the selected Euclidean distances (Euclidian distances) – the geometric distance between objects in multidimensional space:

$$L = \sqrt{\sum_i (x_i - x_i)^2}.$$

Euclidean distance was calculated from the original non-standardized data. In the study, hierarchical cluster analysis was performed using the complete lincage strategy. The rule for building a cluster for a full communication algorithm was:

d(tj, k) = max(d(i,k), d(j,k)),

where – *I* and *j* theobjects are grouped into a cluster *ij*. Using this strategy, the distance between clusters was determined by the greatest distance between two objects from different clusters. Statistical processing of research results was performed using standard programs "Microsoft Excel 2010", "STATISTICA 12.0".

Results

As a result of microbiological research, the predominance of non-fermenting gram-negative bacteria *P. aeruginosa, A. baumannii* among the total population (1227 clinical strains) of opportunistic pathogens isolated from patients with burns was established. As a result of statistical analysis of the distribution of the incidence of infectious complications, it was found that in patients with severe burns during treatment, *P. aeruginosa* microorganisms were isolated in 20.86 % (256 strains) cases. The mean value of the population level of *P. aeruginosa* (M ± m, where m is the error of the mean value of the sample) was 10.67 ± 1.37. Pseudomonas aeruginosa was isolated both in monoculture (4.58 ± 0.59) and in associations (6.08 ± 0.92). A high incidence of severe burns was reported in isolates of *A. baumannii* (24.61 %; 302 strains). The average value of the population level indicator was (12.58 ± 2.79). A similar higher probability of *A. baumannii* in associations with other microorganisms (6.08 ± 1.43) than in monoculture (5.92 ± 1.39).

Graphical analysis of the general distribution of the frequency of occurrence (in monoculture and in associations) of *P. aeruginosa* among patients with burns in the process of their treatment in the context of each year is presented in (Fig. 1).

As a result of a generalized analysis of the results of the study, depending on the day of treatment, it was found that during the first seven days of treatment the average population level of *P. aeruginosa* microorganisms (monoculture and associations) was 6.75 ± 0.89 ($p > 0.05$ ($\tau = 0.12$) between 0 – 7 days of treatment and 7 – 14 days of treatment). In the period from 7 to 14 days, this figure was 7.67 ± 0.89 ($p > 0.05$ ($\tau = 0.12$) between 7 – 14 days of treatment and 14 – 21 days of treatment); during 14 – 21 days 5.5 ± 1.18 ($p < 0.05$ ($\tau = 0.91$) between 14 – 21 days of treatment and 21 – 28 days of treatment); for 21 – 28 days – did not exceed 1.42 ± 0.42. Friedman's analysis of variance showed that a significant difference in the number of *P. aeruginosa* microorganisms isolated from patients over the years of the study is available only between 14 – 21 days of treatment and 21 – 28 days of treatment. There is no significant difference in the frequency of isolation of *P. aeruginosa* from patients between 0 – 7 and 7 – 14 days of treatment, 7 – 14 and 14 – 21 days of treatment.

P. aeruginosa have the highest incidence at 2 weeks of treatment with a gradual decrease in the amount of this microorganism over 3 – 4 weeks. The generalized results of the graphical type of distribution of the appearance of *P. aeruginosa* microorganisms during treatment for 2015 – 2020 are presented in Figure 2.

Figure 1. Graphic analysis of the frequency distribution of clinical strains *P. aeruginosa* among patients with severe burns (2015 – 2020) (according to the Line Plot module of the program "Statistica 12.0").

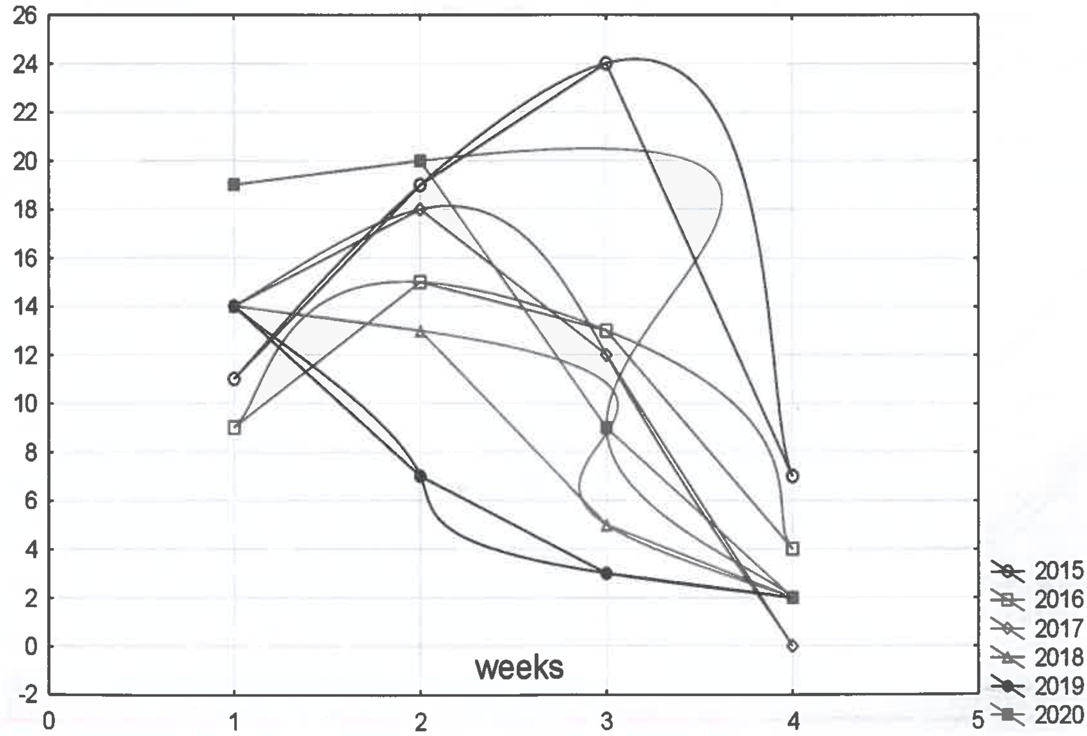
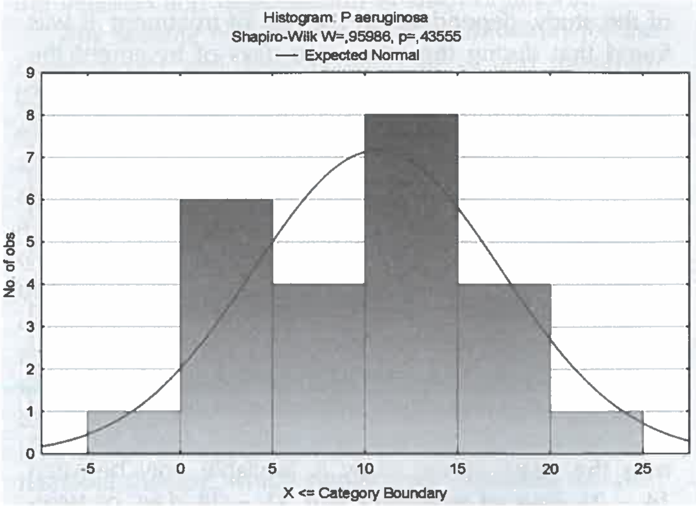


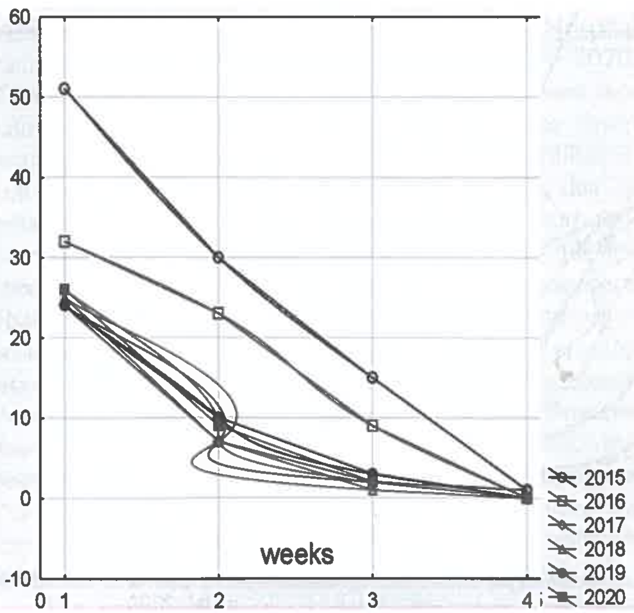
Figure 2. Visual analysis of the type of distribution of *P. aeruginosa* depending on the day of treatment (2015 – 2020) (according to the module Descriptive Statistics of the program "Statistica 12.0").



The main hypothesis for testing was the statement about the normal distribution of the amount of *P. aeruginosa* isolated from patients with burns over the years of the study. The main criterion for checking the normality of data distribution was Shapiro – Wilk's W test ($W = 0.96$; $p > 0.05$) (Fig. 2), according to which it was proved that the amount of *P.aeruginosa* isolated from patients with severe burns over the years of research, distributed according to the normal law.

Graphic analysis of the distribution type of the occurrence frequency of *A.baumannii* (monoculture and in associations) among patients with burn disease during 2015 – 2020 is shown in Figure 3.

Figure 3. Graphic analysis of the type off requency distribution of the microorganism *A. baumannii* among patients with burns in 2015 – 2020 depending on the day of treatment (according to the Line Plot module of the program „Statistica 12.0").

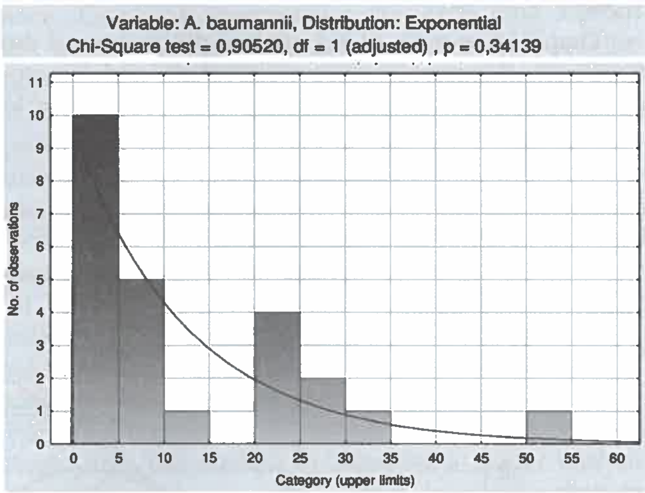


It was found that during the first seven days of treatment the average population level of *A.baumannii* (monoculture and associations) was 15.17 ± 1.53 ($p < 0.05$ ($\tau = 1$) between 0 – 7 days of treatment and 7 – 14 days of treatment). In the period from 7 to 14 days, this figure was 7.17 ± 1.38 ($p < 0.05$ ($\tau = 1$) between 7 – 14 days of treatment and 14 – 21 days of treatment); during 14 – 21 days 2.67 ± 0.98 ($p < 0.05$ ($\tau = 1$) between 14 – 21 days of treatment and 21 – 28 days of treatment); for 21 – 28 days – did not exceed 0.17 ± 0.12 ($p < 0.05$ ($\tau = 0.49$)).

Friedman's analysis of variance showed that a significant difference in the number of microorganisms isolated from patients *A. baumannii* over the years of the study is available between all control days of treatment.

It was found that the microorganisms *A. baumannii* have the highest incidence in the period of hospitalization and 1 week of treatment with a gradual decrease in their number at 2, 3, 4 weeks of treatment. Graphically, the type of distribution of the appearance of microorganisms *A. baumannii* during treatment at 2015 – 2020 is presented in Figure 4.

Figure 4. Visual analysis of the type of distribution of the microorganism *A. baumannii* depending on the day of treatment for the 2015 – 2020 study (according to the Distribution fitting module of the program „Statistica 12.0").



The main hypothesis for testing was the statement about the exponential distribution of the number of *A. baumannii* microorganisms isolated from patients with burns, depending on the day of treatment over the years of study. Chi-square test (Chi-square test = 0.91; $p > 0.05$) was the criterion for checking the exponential distribution of the number of *A. baumannii* microorganisms (Figure 4). According to the Chi-square test criterion, it can be stated that the number of *A. baumannii* microorganisms isolated from patients with severe burns over the years of the study is distributed exponentially.

Thus, the type of distribution of the number of microorganisms depending on the day of treatment is statistically substantiated: exponential distribution law *(A. baumannii),* normal distribution law *(P. aeruginosa).*

Using the method of multidimensional statistical analysis of hierarchical clustering allowed to establish the distribution of antibiotics in clusters according to the degree of sensitivity to them of the studied clinical strains of non-fermenting gram-negative bacteria. First, the most antimicrobial-like antimicrobials were combined, then increasingly different antimicrobials were added to the existing clusters, and as a result, all drugs were combined into one cluster. The results of hierarchical cluster analysis of antimicrobial drugs are presented in the form of a dendrogram.

It was found that clinical strains of *P. aeruginosa* had the highest sensitivity to drugs of the carbapenem group (imipenem – 59.35 %, meropenem – 52.86 % of susceptible strains). Among aminoglycosides, the highest sensitivity of *P. aeruginosa* strains to amikacin was determined by 43.88 % of sensitive strains, and resistant – 37.31 %.

Of the fluoroquinolones, gatifloxacin and moxifloxacin showed the greatest activity against *P. aeruginosa* strains – 37.33 % and 39.74 % of susceptible strains, respectively, resistant – 58.8 % and 54.53 %, and intermediate – 3.77 % and 5.73 %.

From the group of protected penicillins, low sensitivity was found in *P. aeruginosa* strains to amoxicillin / clavulanate, 85.25 % of strains were highly resistant. From the group of fluoroquinolones, *P. aeruginosa* pathogens were the most resistant to pefloxacin (68 % – resistant strains, 18.82 % – sensitive, 13.18 % – intermediate) and ciprofloxacin (67.82 % – resistant strains, 26.76 % – sensitive, 5.42 % – intermediate). From the group of cephalosporins to ceftazidime, cefepime and cefoperazone / sulbactam were isolated 74.24 %, 72.37 % and 51.2 % of resistant strains of *P. aeruginosa*, respectively, 21.48 %, 25.66 % and 35.27 % – sensitive isolates, respectively.

It was found that clinical strains of *P.aeruginosa* were the most sensitive and least resistant to antimicrobial drugs that were in the first cluster: moxifloxacin, gatifloxacin, amikacin, imipenem, meropenem (Fig. 5).

For the first cluster of drugs, the average value of sensitivity and the average value of resistance are respectively: SZCH (M ± σ) = 46.63 ± 8.27 %, SZR (M ± σ) = 46.1 ± 8.89 %.

Second cluster (SZC (M ± σ) = 35.88 ± 0.61 %, SZR (M ± σ) = 55.89 ± 4.69 %): cefoperazone-sulbactam, tobramycin.

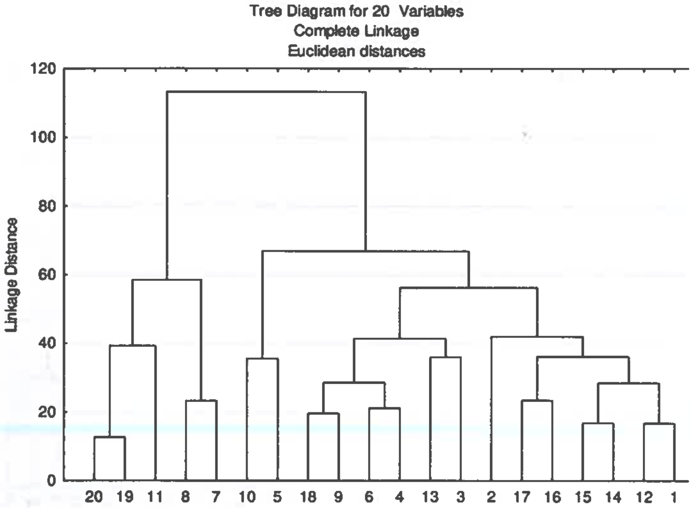
The third cluster can be divided into two subgroups:

Subgroup IIIa (SZCH (M ± σ) = 28.48 ± 8.28 %, SZR (M ± σ) = 69.23 ± 3.9 %): levofloxacin, gentamicin, cefepime, ceftazidime, aztreonam, piperacillin-tazobactam.

Subgroup IIIb (SZCh (M ± σ) = 22.0 ± 3.65 %, SZR (M ± σ) = 70.96 ± 6.15 %): amoxicillin clavulanate, pefloxacin, ciprofloxacin, norfloxacin, ofloxacin, doxycycline, ampicillin-sulbactam.

Thus, the greatest sensitivity of *P. aeruginosa* strains isolated from patients with severe burns was shown to imipenem, meropenem, amikacin, the least sensitive to amoxicillin-clavulanate, aztreonam, pefloxacin, norfloxacin.

Figure 5. Copy of the screen of the program "Statistica 12.0": the results of hierarchical clustering of sensitivity and resistance of *P. aeruginosa* to antimicrobial drugs. 1 – ampicillin-sulbactam, 2 – amoxicillin-clavulanate, 3 – piperacillin-tazobactam, 4 – ceftazidime, 5 – cefoperazone-sulbactam, 6 – cefepime, 7 – imipenem, 8 – meropenem, 9 – gentamicin, 10 – tobramycin, 11 – amikacin, 12 – doxycycline, 13 – aztreonam, 14 – norfloxacin, 15 – ofloxacin, 16 – pefloxacin, 17 – ciprofloxacin, 18 – levofloxacin, 19 – gatifloxacin, 20 – moxifloxacin.



Clinical strains of *A. baumannii* were found to be the most sensitive to polymyxin and cefoperazone-sulbactam: sensitive strains – 82.64 % and 50.98 %, respectively, resistant – 13.31 % and 30.0 %.

Of the aminoglycosides, the most active drugs were gentamicin (32.56 % of sensitive strains, and resistant – 51.35 %) and tobramycin (43.56 % of sensitive strains, and resistant – 57.09 %).

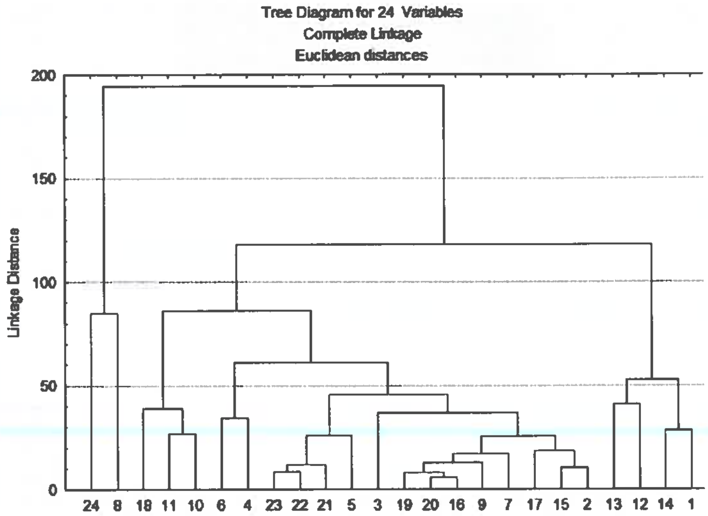
From the group of protected penicillins, ampicillin-sulbactam showed the greatest activity against *A. baumannii* – 47.83 % of sensitive strains, intermediate strains – 11.4 %, resistant – 40.77 % (Fig. 6).

Of the fluoroquinolones, ofloxacin was the most active against *A. baumannii*, with 23.61 % of susceptible isolated strains. 35.53 % and 32.66 % of sensitive strains, respectively, were assigned to carbapenems (imipenem, meropenem). From the group of cefalosporins – ceftriaxone (17.93 % of susceptible strains) and cefoperezone (10.84 % of susceptible strains) were weakly active. Of the newest (fourth generation) cefalosporins, cefepime (4.25 % of susceptible strains) showed extremely low activity against *A. baumannii* strains isolated from burn patients.

A. baumannii showed resistance to piperacillin-tazobactam – 80.22 % resistant strains, pefloxacin (93.46 % resistant strains) and ciprofloxacin (89.53 % of resistant strains).

The first cluster included the following antimicrobials: polymyxin, cefoperazone-sulbactam. For the first cluster of drugs, the average value of sensitivity and the average value of resistance are respectively: SZCH (M ± σ) = 66.81 ± 15.83 %, SZR (M ± σ) = 21.66 ± 8.35 %.

Figure 6. Copy of the screen of the program "STATISTICA 12.0". The results of hierarchical clustering of susceptibility and resistance of A. baumannii to antimicrobial drugs. 1 – ampicillin-sulbactam, 2 – amoxicillin-clavulanate, 3 – piperacillin-tazobactam, 4 – cefoperazone, 5 – cefoperazone-cefotaxime, 6 – ceftriaxone, 7 – ceftazidime, 8 – cefoperazone-sulbactam, 9 – cefepime, 10 – imipenem, 11 – meropenem, 12 – doxycycline, 13 – gentamicin, 14 – tobramycin, 15 – amikacin, 16 – aztreonam, 17 – norfloxacin, 18 – ofloxacin, 19 – pefloxacin, 20 – ciprofloxacin, 21 – levofloxacin, 22 – gatifloxacin, 23 – moxifloxacin, 24 – polymyxin.



Second cluster: doxycycline, gentamicin, tobramycin, ampicillin-sulbactam. SZCH (M ± σ) = 41.41 ± 6.45 %, SZR (M ± σ) = 49.32 ± 7.53 %.

Third cluster (SZCH (M ± σ) = 30.6 ± 5.29 %, SZR (M ± σ) = 65.72 ± 6.18 %): ofloxacin, imipenem, meropenem.

The fourth cluster can be divided into four homogeneous subgroups.

Subgroup IVa: gatifloxacin, moxifloxacin, levofloxacin, cefotaxime. SZCH (M ± σ) = 14.62 ± 2.8 %, SZR (M ± σ) = 82.55 ± 1.43 %.

Subgroup IVb: cefoperazone, ceftriaxone. SZCH (M ± σ) = 14.39 ± 3.56 %, SZR (M ± σ) = 62.75 ± 8.25 %.

Subgroup IVc: amikacin, norfloxacin, amoxicillin clavulanate. SZCH (M ± σ) = 11.48 ± 0.79 %, SZR (M ± σ) = 80.98 ± 2.18 %.

Subgroup IVd: piperacillin-tazobactam, pefloxacin, ciprofloxacin, aztreonam, ceftazidime, cefepime. SZCH (M ± σ) = 7.00 ± 3.87 %, SZR (M ± σ) = 88.96 ± 5.22 %.

Thus, the greatest sensitivity of *A. baumannii* strains isolated from patients with severe burns was shown to polymyxin, cefoperazone-sulbactam, doxycycline, tobramycin, ampicillin-sulbactam. Antimicrobial drugs were slightly less sensitive: gentamicin, ofloxacin, imipenem, meropenem. The greatest resistance of *A. baumannii* strains was shown to amikacin, norfloxacin, amoxicillin-clavulanate, piperacillin-tazobactam, pefloxacin, ciprofloxacin, aztreonam, ceftazidime, cefepime.

Discussion

According to the monitoring carried out in Ukraine in 2004 – 2007, imipenem and ceftazidime are the most effective against *P. aeruginosa* strains – 85.2 and 78.6 % of susceptible strains, respectively (20).

High resistance of acinetobacteria in 2015 to fluoroquinolones (ciprofloxacin – 96.1 %; gatifloxacin – 95.8 %), due to the widespread use of these antibiotics for the treatment of burns was reported. A similar trend was observed for carbapenems. In particular, clinical strains of A. baumannii were resistant to meropenem (83.8 %) and imipenem (57.9 %). The results reflect the trend of changing the antibiotic susceptibility profile of *A. baumannii* from multidrug-resistant (MDR) to extensively resistant (XDR), which is a serious problem in modern treatment of infections caused by this group of microorganisms (19).

According to researchers in the United States, among the pathogens isolated from patients with burns, antibiotic-resistant strains of *A. baumannii* (53 %), methicillin-resistant *S. aureus* (MRSA) (34 %), *K. pneumoniae* (17 %) and *P. aeruginosa* (15 %) are multidrug-resistant. Also among *A. baumannii* and *P. aeruginosa* the scientists register the appearance of strains identified as resistant to all 4 classes of tested antibiotics, including colistin (12).

Therefore, it is important to monitor the world-wide problem of multidrug-resistant strains'spreading and find ways to overcome it (2, 10, 28).

Data from Tarafdar F, Jafari B, Azimi T. (Iran, 2020) confirm a high level of antibiotic resistance isolated from patients with burns of non-fermenting gram-negative bacteria *P. aeruginosa* (100 % isolates) and *A. baumannii* (98 % strains) to ceftriaxone and ceftaxamone in accordance. The lowest resistance of *P. aeruginosa* isolates (54.1 %) was shown for ceftazidime (26).

Thus, the results of studies indicate a widespread prevalence of antibiotic-resistant strains of *A. baumannii* and *P. aeruginosa* isolated from patients with burns in different countries. The results of current studies on the susceptibility of clinical strains of *Pseudomonas aeruginosa* and *Acinetobacter baumannii* from different countries differ from the data obtained by us, which may indicate the peculiarities of microorganisms' resistance to antibiotics in different institutions depending on treatment protocols for patients with burns and features of phenomena of antibiotic resistance of microorganisms in different countries.

Therefore, it is essential to implement continuous screening and monitoring programs to identify, predict and create ways to combat the spread of antibiotic resistance among infectious agents in patients with burns (11, 24).

Conclusion

1. During 2015 – 2020, the distribution of the number of non-fermenting gram-negative bacteria strains isolated from patients with burns depending on the day of treatment belong to the exponential distribution

law for *A. baumannii* and the normal distribution law for *P. aeruginosa*, which, in our opinion, should be taken into account in appointment and correction of antimicrobial drugs.

2. Strains of *P. aeruginosa* isolated from patients with severe burns showed the greatest sensitivity to imipenem, meropenem, amikacin, were least sensitive to amoxicillin-clavulanate, aztreonam, pefloxacin, norfloxacin.
3. Strains of *A. baumannii* isolated from patients with severe burns are the most sensitive to polymyxin, cefoperazone-sulbactam, doxycycline, tobramycin, ampicillin-sulbactam. Gentamicin, ofloxacin, imipenem, meropenem had lower antimicrobial activity against *A. baumannii* strains.*

***Conflicts of interest.** The authors declare that there is no conflict of interest.

Compliance with Ethics Requirements: The authors declare, that all the procedures and experiments of this research respect the ethical standards in the Helsinki Declaration.

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Corresponding author:
MUDr. Oleksandr Dobrovanov, PhD., MBA
The Hospital of Saint Cyril and Metod
A. Getlik Clinic for Children and Adolescents
Slovak Medical University and University Hospital
Antolska 11
851 07 Bratislava
E-mail: *brovan.oleksandr@gmail.com*