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Dynamics of the Microbiological Scape and Antibiotic Susceptibility in Intensive Care Unit Patients

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ABSTRACT

The papers deal with a problem of decrease of antibiotic resistance by the introduction of proposed prevention and control complex in the intensive care unit. Data from 1111 bacteriological analyses taken from patients, who got treatment in the period from January to August 2015 (group 1) and the same period of 2018 (group II), were included in the study. The complex included: measures for the prevention of antibiotic resistance spread and rational antibiotic use. Resistance to imipenem changed the most. The last increased by 60% (p≤0,05), which consisted of Ps. Aeruginosa isolates for 100%. A decrease in 39% of polyresistant clinical isolates of Klebsiella pneumonia in patients of I and II have important prognostic values. A complex of proposed measures included the division of patients in blocks according to the risk of infectious complications, control of antibiotics administration, adherence to sanitary norms by ICU staff, use of sodium hypochlorite lead to the decrease of pathogenic isolates and level of antibiotic resistance to specific groups of antibacterial drugs

Keywords: Antibiotic Susceptibility, Antibiotic Resistance, Microbiological Scape.

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INTRODUCTION

Antibiotic resistance of microflora is a complex medical, social and economic problem.[1] Antibiotic-resistant bacteria can become a cause of death of 10 billion people a year by 2050.[2,3] Several international policies addressed the issues of antimicrobial resistance, which include European strategic action plan on antibiotic resistance and Global action plan on antimicrobial resistance announced by WHO.

One of the critical factors is a decrease of risk of formation and spread of nosocomial strains of microorganisms, that have resistance to antimicrobials through the development and implementation of an effective program of infection control in hospitals.[4]

MATERIALS AND METHODS

Taking into account the speed of formation and spread of antibiotic resistance, it is a need in antibiotics of a new generation, but this is a longtime process.[5,6] Different strains of pathogens have known resistance to antibiotics, including multi-drug resistant strains.[7] Analysis of 1111 bacteriological investigations from patients, who were treated in ICU of Ternopil university clinics for the period from January to August 2015 (group I) and the same period of 2018 (group II), were included in the study. The complex included: measures for the prevention of antibiotic resistance spread and rational antibiotic use. Patients were divided into blocks according to the probability of infectious complications. Block A consisted of patients with purulent infections or high risk of infectious complications. Block B consisted of postoperative patients, who demands intensive care and have a low risk of infectious complications. Block C included patients after cardiac surgery with the lowest risk of infectious complications. Each block contained the principle of "cocoon": individual mechanical ventilation device, cardiovascular monitor, suction unit, stethoscope, blood pressure device, antiseptics for personal, who was in contact with the patient. One nurse worked with a maximum of 2 patients, taking into account the insufficiency of staff. The strict control of hands and medical cloths hygiene was performed (daily change of clothes and restriction to move to different blocks in the same cloths), prevention of catheter-associated infections of the blood, urinary tract, ventilator-associated infections of the respiratory tract, constant education among the staff of all surgical departments were performed.

We controlled the administration of antibiotics according to the guidelines and recommendations, avoided causeless preventive administration of antibiotics, that allowed to decreased their administration in departments of minimally invasive surgery and orthopaedics in 3 times. Patients with the purulent process, especially with determined antibiotic resistance, underwent electrochemical detoxication, with the administration of sodium hypochlorite solution in a dose of 600 mg/l with the dose per administration equal to 1/10 of circulating blood volume. The mechanism of action consists of the oxidation of hydrophobic toxins by active oxygen. Sodium hypochlorite is a transporter of active oxygen, which participates in phagocytosis and improve detoxication function of the liver. Repeated analysis for antibiotic resistance was performed on the 3rd day of electrochemical detoxication.

Analysis of the biologic material and interpretation of results of the microbiological investigation were performed according to the typical recommendations.[7,3] We used Berey classification. After the primary isolation of the causative agent, we used Kdisc-diffusion to identify antibiotic susceptibility (Kirby-Bauer).[1]

RESULTS

After the analysis of obtained data we found, that amount of Klebsiella pneumoniae strains isolated from the group II patients decreased in 39 % ($p \leq 0.05$) when compared to the group I patients (Fig. 1).

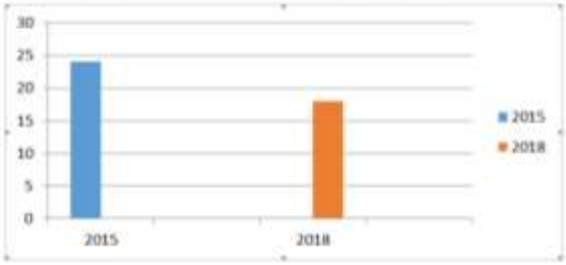

Fig. 1: Amount of isolated Klebsiella pn. from patients during study years

After assessment of Ps. Aeruginosa we found, that the prevalence of this microorganisms in group II patients decreased by 17 % ($p \leq 0.05$) when compared to the group I patients (Fig. 2).

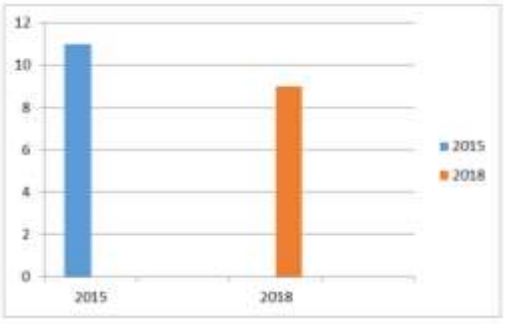

Fig. 2: Amount of isolated Ps. Aeruginosa from patients during study years

The level of Acinetobacter spp. increased by 25 % ($p \leq 0.05$) in group II, which corresponded with the world tendencies (Fig. 3).

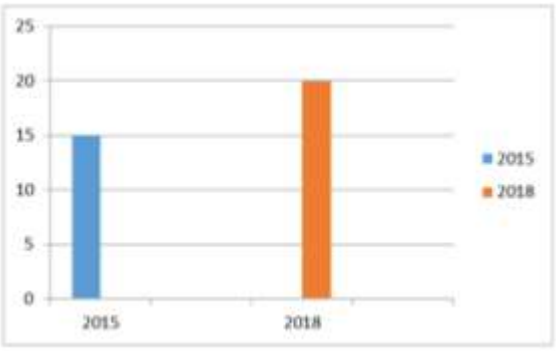

Fig. 3: Amount of isolated Acinetobacter spp. from patients during study years

After assessment of antibiotic susceptibility of studied strains, we found an increase in Acinetobacter spp. susceptibility to imipenem from 16.7 % in group I patients to 100 % in group II patients ($p \leq 0.05$).

Analysis of susceptibility of Ps. aeruginosa found that the susceptibility it meropenem remained at the same level (16.7 %) ($p \leq 0.05$) (Table 1).

Table 1: Antibiotic susceptibility of Ps. Aeruginosa

Group I				Group II			
Antibiotic	% R	% I	% S	Antibiotic	% R	% I	% S
Amikacin	37.5	0	62.5	Amikacin	33.3	0	66.7
Cefepime	0	0	100	Cefepime	16.7	0	83.3
Cefoperazone	100	0	0	Cefoperazone	100	0	0
Ceftazidime	85.7	0	14.3	Ceftazidime	75	0	25
Gatifloxacin	100	0	0	Ciprofloxacin	100	0	0
Gentamicin	50	0	50	Clindamycin	100	0	0
Imipenem	50	10	40	Gatifloxacin	100	0	0
Meropenem	83.3	0	16.7	Imipenem	0	0	100
Piperacillin	0	66.7	33.3	Levofloxacin	100	0	0
Tetraciclin	0	0	0	Linezolid	100	0	0
Tabromicin	42.9	14.3	42.9	Meropenem	83.3	0	16.7
-	-	-	-	Vancomicyn	100	0	0
-	-	-	-	Erapenem	100	0	0

Susceptibility to amikacin and ceftazidime increased by 6.72 and 42.8 % correspondingly ($p \leq 0.05$).

Taking into account the presence of poly resistant clinical isolates of Klebsiella pneumoniae in group I and II patients a decrease of their amount by 39 % has a crucial prognostic meaning (Table 2).

Table 2: Antibiotic susceptibility of Klebsiella pneumonia

Group I				Group II			
Antibiotic	% R	% I	% R	Antibiotic	% R	% I	% R
Amikacin	36.8	0	63.2	Amikacin	54.5	0	45.5
Amoxicillin	0	0	0	Amoxicillin	0	0	0
Cefepime	83.3	0	16.7	Cefepime	95.2	0	4.8
Cefoperazone	0	0	100	Cefoperazone	91.7	0	4.8
Cefotaxime	94.1	0	5.9	Cefotaxime	88.9	0	11.1
Ceftazidime	94.6	0	5.4	Ceftazidime	96.2	0	3.8
Ceftriaxone	94.7	0	5.3	Ceftriaxone	95.8	0	4.2
Cefuroxime	81.8	0	18.2	Ciprofloxacin	85.7	0	14.3
Gatifloxacin	95	0	5	Gatifloxacin	100	0	0
Gentamicin	50	0	50	Gentamicin	40	0	60
Imipenem	87.9	3	9.1	Imipenem	88.9	5.6	5.6
Levofloxacin	83.3	0	16.7	Levofloxacin	90.9	0	9.1
Meropenem	95.8	0	4.2	Meropenem	83.3	0	16.7
Ofloxacin	94.7	0	5.3	Ofloxacin	50	0	50
Ertapenem	66.7	0	33.3	Ertapenem	84.6	0	15.4
Tigecycline	0	0	0	Piperacillin	92.3	0	7.7
Piperacillin	83.3	11.1	5.6	Tetracycline	0	0	0
Tetracycline	0	0	0	Tobramycin	65	0	35
Tobramycin	17.4	8.7	73.9	Ticarcillin	0	0	0
Aztreonam	100	0	0				
Ticarcillin	0	0	0				

Increased of antibiotic susceptibility of clinical isolates of Klebsiella pneumonae was determined to gentamycin and ofloxacin by 16.7 % and 89.4 % correspondingly ($p \leq 0.05$) (Table 2).

A tendency towards an increase of antibiotic susceptibility of clinical strains of Acinetobacter spp. to meropenem was found: increased of susceptibility form 0 to 30 % ($p \leq 0.05$) (Table 3).

Table 3: Antibiotic susceptibility of Acinetobakter spp.

Group I				Group II			
Antibiotic	% R	% I	% S	Antibiotic	% R	% I	% S
Amikacin	80	0	20	Amikacin	85.7	14.3	0
Cefoperazone	100	0	0	Amoxicillin	100	0	0
Ceftazidime	92.3	0	7.7	Cefepime	90	0	10
Gatifloxacin	80	0	20	Cefoperazone	84.6	0	15.4
Gentamicin	100	0	0	Ceftazidime	93.3	0	6.7
Imipenem	83.3	0	16.7	Ciprofloxacin	100	0	0
Levofloxacin	100	0	0	Gatifloxacin	75	8.3	16.7
Meropenem	80	20	0	Gentamicin	50	0	50
Ertapenem	0	0	0	Imipenem	0	0	100
Tigecycline	0	0	0	Kanamycin	100	0	0
Piperacillin	25	75	0	Levofloxacin	92.5	0	7.1
Tetracycline	0	0	0	Meropenem	70	0	30
Tobramycin	50	0	0	Ertapenem	0	0	0
Ticarcillin	0	0	100	Piperacillin	80	20	0
				Tetracycline	0	0	0
				Tobramycin	75	0	25
				Ticarcillin	100	0	0

DISCUSSION

The most significant changes of antibiotic susceptibility were determined to imipenem. It increased by 60 % ($p \leq 0.05$), which consisted of 100 % susceptibility of clinical isolates of Ps. aeruginosa to imipenem.

Taking into account remaining poly resistant clinical isolates of Klebsiella pneumoniae in group I and II patients, a decrease of their amount by 39 % has an outstanding prognostic value.

Acinetobacter spp. were not susceptible to cefoperazone/sulbactam in group I patients, while 15.4 % of strains were susceptible to this antibiotic in the group II patients. Data on some of the antibiotics correlate with other studies conducted in our country.[8,9]

CONCLUSIONS

A complex of proposed measures: the division of patients in blocks according to the risk of infectious complications, control of antibiotics administration, adherence to sanitary norms by ICU staff, use of sodium hypochlorite lead to the decrease of pathogenic isolates and level of antibiotic resistance to specific groups of antibacterial drugs; caused a decrease in the amount of pathogenic isolates and antibiotic resistance level to certain antibiotics without high expenses. Assessment of the microbiological scape of the departments with antibiotic susceptibility analysis of isolated clinical isolates should be an obligatory part of the administration of the antibiotic.

ETHICAL CLEARANCE

Approved.

SOURCE OF FUNDING

Nil

CONFLICT OF INTEREST

None.

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