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Nosocomial Infections (NI) in Patients with Artificial Pulmonary Ventilation

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Abstract: ***Artificial pulmonary ventilation (APV) delivered in Intensive Care Units (ICU) is a major risk factor for the progress of Nosocomial infections (NI). Despite of the introduction of respirators with maximum physiological ventilation regimes, new medications and strict hygiene and sterility measures in the modern intensive care units, morbidity and mortality rates associated with Nosocomial infections remain high. The additional financial costs of the hospitals due to NI are considerably high. Objective: The progress of Nosocomial infections in the Clinic for Anaesthesiology and Intensive Care at Alexandrovska University and Multispecialty Hospital for Active Treatment to be studied for a period of 5 years. Method: 720 patients treated in the Clinic for Anaesthesiology and Intensive Care for the period 2010-2015 were prospectively studied. 381 of them were mechanically ventilated and a prospective collection and processing of demographic, clinical, paraclinic, microbiological and epidemiological data was conducted. Results: The allocation of patients was presented in terms of the duration of mechanical ventilation, type of surgical intervention (if performed), concomitant pathology, demographic characteristics, stay in ICU, types of NI, microbiological profile and invasive procedures performed. Conclusions: The prevention of Nosocomial infections is multi-profile and multi-component one. Microbiological monitoring, strictly specified antibiotic therapy, treatment of concomitant diseases and local infectious control in ICU are of key importance.***

Keywords: ICU, Nosocomial infections, Artificial pulmonary ventilation.

1. Introduction

Over the last few years, the artificial pulmonary ventilation and associated invasive procedures (intubation, reintubation, tracheostomy, central and/or peripheral arterial or venous sites, nasogastric tubes) have won recognition as the primary lifesaving methods in the intensive care units. With the advancement and creation of new kinds of respirators and alternative regimes, the mechanical ventilation makes its way on a mass scale in everyday practice. There is a significant increase in the number of ICU patients who need assisting in breathing. The number of patients in artificial pulmonary ventilation ranges from 20 to 60% of the total number of patients undergone ICU.

Artificial pulmonary ventilation ranks among the main risk factors for the progress of Nosocomial infections. This causes increased morbidity and mortality rates and thence, significant financial hospital costs. The rate of mortality in artificial pulmonary ventilation patients still remains relatively high and reaches 15%-60%, despite of the use of complex diagnostic techniques and potent chemotherapeutics.

Nosocomial infections (from Greek **ηοςος** - disease and **κομειηι** – take care for) are infections that occur during patients' stay in hospital. Prior to patients' hospitalization, they had not been in period of progress. Nosocomial infections often result from complications after different serious diseases and traumas. Not fully precised diagnostic criteria and variations in patients' demographic characteristics make it impossible to accurately determine their frequency. It is considered that it ranges in 20% to 50% of patients which have stayed in intensive care units.

The clinical environment of the above type of hospital structure is characterized with concentration of differing and seriously ill patients, performing of modern diagnostic and therapeutic manipulations, many of them being invasive manipulations which break patients' natural protective mechanisms.

The main Nosocomial infections in intensive care units in patients in artificial pulmonary ventilation are:
- Respiratory associated nosocomial pneumonia
- Catheter associated nosocomial infection
- Catheter associated urinary tract nosocomial infection
- Surgical site nosocomial infection

Most Nosocomial infections are diagnosed between the first and the fourth day after admission to ICU. They are classified as early and late infections. Early infections, such as primary endogenous infections are characterized by foudroyant (violent) run and specific bacterial agents are present. Late infections progress after the 4th day and most often they are caused by resistant gram (-) bacteria.

The world science literature has a great number of studies and recommendations for solving the problem with Nosocomial infections in the intensive care units. More in number are the publications which study spontaneously breathing patients. Less are the studies related to prevention, origin, progress and treatment of these infections in patients in artificial pulmonary ventilation. There is no one and the same opinion on this issue. The scientific interest to be found the most appropriate method for prophylaxis, diagnosis and treatment of Nosocomial infections in patients in artificial pulmonary ventilation is still on-going.

The aim of the present study is to analyse the different types of Nosocomial infections in patients in artificial pulmonary ventilation.

2. Study Formulation

The study is performed in the Clinic for Anaesthesiology and Intensive Care at Alexandrovska University and Multispecialty Hospital for Active Treatment for the period 2010-2015. 720 patients treated in the clinic for this time period were studied. The reasons for hospitalization were different. The leading etiological factor necessitates the performance of mechanical ventilation. Present or expected breathing support by respirator for different periods of time is the key criterion for involvement in the study.

All 381 patients in mechanical ventilation were subject to prospective collection and processing of demographic, clinical, paraclinic, microbiological and epidemiological data. This has given the opportunity Nosocomial infections, mortality rate and risk factors in patients in artificial pulmonary ventilation to be followed in dynamics and the frequency to be analysed.

Clinical contingent

The study involves 381 patients with clinical picture compatible with acute respiratory failure which needs artificial pulmonary ventilation for varying periods of time. The reasons for hospitalization are different, with a main reason being the need to start and/or continue the mechanical ventilation. The general measures of treatment process in these patients include:

a) Maintaining an open airway through endotracheal intubation (orthotracheal, nasotracheal) or planned tracheostomy;
b) Artificial pulmonary ventilation for different period of time;
c) Fluid therapy to maintain the basic parameters of homeostasis with increased or normal water-electrolyte balance;
d) Enteral and/or parenteral nutrition, depending on the clinical condition of the patients
e) Medication therapy aiming at:
   - Empirical or purposive antibiotic therapy;
   - Prophylaxis of the gastrointestinal tract;
   - Protective therapy for patients with craniocerebral trauma;
   - Prophylaxis of thrombotic complications;

Table 1 presents the etiological reasons which necessitate continued mechanical ventilation.

Table 1: Etiological reasons for mechanical ventilation

Etiological Factor	Number (% of the total number)
Multiple trauma	121 (31%)
Isolated craniocerebral trauma	25 (7%)
Isolated thoracic trauma	36 (9%)
Postoperative respiratory failure	67 (18%)
Infections of the lung	76 (20%)
Infection of genital origin	41 (11%)
Others	15 (4%)
Total number	381

216 of the patients were ventilated at the time of mechanical ventilation by intubation tube. In 165 patients, mechanical ventilation by intubation tube was performed in the beginning, followed by insertion of tracheostomy cannula through percutaneous tracheostomy (on average 14-17 days from the beginning of artificial pulmonary ventilation). The second group of patients mainly refer to those with serious multiple trauma and isolated craniocerebral trauma.

Table 2 presents the allocation of the patients' contingent in artificial pulmonary ventilation by sex and by age.

Table 2: Allocation of the patients by sex and by age

Total Number	SEX		AGE /in years/
n	m	f	x ± Sx
381	260	121	51.72±13.47

The allocation of the patients admitted in the Clinic for Anaesthesiology and Intensive Care for treatment by years is presented in Table 3.

Table 3: Allocation of patients by years

Years	Total number of admitted patients	Patients in artificial pulmonary ventilation (% of the total number for the year)
2010	128	59 (46%)
2011	119	64 (53%)
2012	102	58 (56%)
2013	121	63 (52%)
2014	116	69 (59%)
2015	134	68 (50%)
Total number	720	381 (53%)

The allocation of the patients in artificial pulmonary ventilation by years depending on sex is presented in Table 4.

Table 4: Allocation of patients by years depending on sex

Years	*Number*	
	male	*female*
	(% of the patients in artificial pulmonary ventilation)	
2010	41 (69%)	18 (31%)
2011	40 (62%)	24 (38%)
2012	39 (67%)	19 (33%)
2013	43 (68%)	20 (32%)
2014	48 (70%)	21 (30%)
2015	49 (71%)	19 (29%)
Total number	260(68%)	121 (32%)

Table 5 presents by years the data obtained for patients in artificial pulmonary ventilation in terms of their age, height and body weight.

Table 5: Demographic data of the patients

Years	Age (in years)	Height (cm)	Body weight (kg)
2010	51.72±12.78	168.11±10.23	70.13±9.57
2011	53.53±14.31	167.37±11.87	71.54±10.34
2012	52.74±14.94	166.46±10.34	69.47±11.26
2013	54.81±13.89	167.21±10.26	69.78±10.71
2014	55.21±12.67	165.78±11.57	72.38±12.63
2015	54.73±17.47	166.37±10.65	69.52±11.89

3.4 Statistical Methods

Statistical analysis was performed by application of the statistical software Statistica 3.0 for Windows and the Biomedical Data Processing Program (BMDP).
The statistical survey goes through the following succession:
a) Statistical monitoring
b) Statistical grouping
c) Statistical analysis

The statistical monitoring is conducted by recording the data gotten in the survey. The values of the indications of interest for the concrete statistical survey are recorded. The aim of the statistical grouping, as a second stage of the statistical survey, is to fulfil the division of the units. Simple and complex groupings have been made – according to one or more group indications. The statistical analysis as a final stage of the statistical survey covers all methods and means of statistics for obtaining aggregated data for interpretation.

The following methods of statistical analysis are applied:
a) Determination of statistical values - absolute, relative and average ones
b) Statistical assessment (statistical inferences and conclusions)
   - Alternative analysis
   - Dispersion analysis
   - Trustful, guaranteed probability and reliability
   (in the framework of the whole study a guaranteed probability was accepted $(1-\alpha) = 0.95$ if $\alpha = 0.05$ (5% error)
   - Statistical hypothesis testing
c) Correlation analysis
d) Regression analysis
e) Multiple regression analysis

3. Results and Discussion

The total number of patients admitted in the Clinic for Anaesthesiology and Intensive Care was 720 patients for the entire study period. 381 (53%) of them were in artificial pulmonary ventilation for the period 2010-2015. 132 patients were on spontaneous breathing with face mask for Oxygen at the moment of admitting, and 249 of them were in artificial pulmonary ventilation. 125 of them were tracheostomized later. The number of patients tracheostomized before their hospitalization was 40.

Table 6 presents the allocation of patients according to the duration of artificial pulmonary ventilation during their stay in the Clinic for Anaesthesiology and Intensive Care.

Table 6: Allocation of patients according to the duration of artificial pulmonary ventilation in the Clinic for Anaesthesiology and Intensive Care

Duration of artificial pulmonary ventilation	Number of patients (% of the total number of patients in artificial pulmonary ventilation)
Up to 72 hours	12 (3%)
Up to 6 days	34 (9%)
Up to 12 days	61 (16%)
Up to 16 days	91 (24%)
Up to 20 days	102 (27%)
More than 20 days	81 (21%)
Total number	381

In Table 6 it can be seen that the number of patients in artificial pulmonary ventilation for more than 12 days is the highest. This group of patients necessitates considerable efforts and financial costs during their treatment. The highest percentage of progress of Nosocomial infections is determined exactly with them in the clinic.

The average values obtained for the average duration of artificial pulmonary ventilation during the stay of the patients in the clinic in recent years are presented in Table 7.

Table 7: Duration of artificial pulmonary ventilation

Years	Duration of artificial pulmonary ventilation (in days) x±Sx
2010	12.34±2.76
2011	11.48±3.12
2012	14.27±1.89
2013	15.38±2.32
2014	18.35±1.89
2015	21.31±2.53
Average duration	18.74±9.3

From Table 7 it can be seen that in the last years of the study, a trend is observed for increasing the duration of artificial pulmonary ventilation, as the highest values were recorded in the last two years 2014 and 2015. During these two years, the number of patients treated in the Clinic for Anaesthesiology and Intensive Care (Table 3) was the highest.

According to the characteristics of the surgical intervention performed, the patients are presented in Table 8.

Table 8: Allocation of patients according to the surgical intervention performed

Surgical intervention	Number	Percentage of the total number of patients in artificial pulmonary ventilation (%)
Operated patients	118	31%
Not operated patients	263	69%
Operated in emergency	89	23%
Planned surgery	29	8%

In Table 8 it can be seen that the percentage of patients who have not undergone surgical intervention was the highest. Second are the patients who have undergone surgical intervention as in 89 of them (23%) it is performed in result of urgent indications. In 29 patients (8%), the surgical intervention was performed in a planned order.

In emergency operated patients (89), 121 surgical interventions were performed. The number of abdominal, neurosurgical and thoracic-abdominal interventions prevails (Table 9).

Table 9: Allocation of the patients according to the urgency of surgical intervention

Operation	Number of operations performed	(% of the total number of patients in artificial pulmonary ventilation)
Abdominal:		
Upper floor of the abdomen	27	7%
Lower floor of the abdomen	21	5%
Thoracic	19	4%
Thoracic abdominal	20	5%
Neurosurgical	23	6%
Traumatological	11	2%

In Table 9 it is found that urgent surgical interventions rate is the highest in the upper floor of the abdomen, followed by those resulting from craniocerebral trauma. The percentage of traumatic operations is the lowest.

Table 10 presents the allocation of patients depending on their concomitant diseases.

Table 10: Concomitant diseases

Concomitant diseases	Number of patients (% of the total number of patients in artificial pulmonary ventilation)
Pulmonary pathology	53 (14%)
Cardiovascular pathology	19 (5%)
Insulin-dependent type of diabetes	25 (6%)
Obesity	11 (3%)

In Table 10 it is found that the percentage of patients with pulmonary pathology is the highest, followed by those with diabetes and cardiovascular pathology. Finally stay patients with obesity, though with the lowest percentage of the total number of patients in artificial pulmonary ventilation. This group causes significant difficulties during the treatment process.

Table 11 presents the data obtained for :

- Average treatment stay;
- Number of deceased patients;
- Lethality.

Table 11: Statistical data obtained during the treatment

Years	Average stay (in days) (x±Sx)	Number of deceased patients	Total number for the year	Mortality rate (% of the total number of the patients for the year)	Mortality rate (% of the number of the patients in artificial pulmonary ventilation)
2010	21.18±3.62	29	128	23%	49%
2011	20.05±4.12	28	119	23%	43%
2012	25.23±3.79	24	102	24%	41%
2013	21.58±2.79	25	121	21%	40%
2014	18.49±1.58	21	116	18%	30%
2015	17.35±2.47	19	134	19%	28%
Total number		146	720	20%	38%

From the results presented in Table 11 it is clear that during the studied years a reduction in the average treatment stay of patients is recorded. The percentage is the lowest in the last years of the survey. The number of deceased patients tends to decrease as the lowest mortality rate is recorded in 2014 and 2015.

The last two columns present the results obtained in terms of lethality in the Clinic for Anaesthesiology and Intensive Care. Despite of the increasing number of patients admitted and treated during the studied period of years, a significant reduction of the overall mortality rate is recorded, which is the lowest in 2014 and 2015. The average overall mortality rate for the sixth years of the survey is 20% and it is due to the lower mortality rate in the last years.

When calculating the mortality rate depending on the number of patients to whom is delivered or not delivered mechanical ventilation, a significant increase is observed in patients in artificial pulmonary ventilation. The mortality rate reaches an average value of 38% for all studied years. In the first years of the survey, its highest value was 49%, as it reduced significantly in the following years, reaching a value of 28%. This indicates that the delivery of artificial pulmonary ventilation as a method for saving life and conducting the treatment process is connected with increase of the death incidence value from 20% to 38% compared to patients with no artificial pulmonary ventilation performed.

The duration of artificial pulmonary ventilation varies over the years. The most continuous pulmonary ventilation performed in patient is 112 days and the shortest one is 72 hours.

Table 12 presents the data for:

- Days of hospitalization;
- Average stay in resuscitation;
- Total number of artificial pulmonary ventilations;
- Average duration of artificial pulmonary ventilation.

Table 12: Days of hospitalization and days in artificial pulmonary ventilation

Indicators	Values (in days)
Total number of days of hospitalization	12 591
Average stay	31.62±12.54
Total number of days in artificial pulmonary ventilation	6 986
Average duration of artificial pulmonary ventilation	18.74±9.3

In Table 12 it is found that the artificial pulmonary ventilation performed covers about 40% of the patients' stay days in the clinic. The rest of the time, they were actively monitored and treatment was performed before their placing in artificial pulmonary ventilation as well as after the termination of assisting their breathing by respirator. This is a period of time when patients are put to renewed increased

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risk of progress of new Nosocomial infections which cause worsening of their clinical condition and necessitates their placement again in artificial pulmonary ventilation.

Nosocomial infections in patients in artificial pulmonary ventilation

Nosocomial infections were found in 381 patients in artificial pulmonary ventilation, which represents 53% of the total number of 721 patients hospitalized in the Clinic for Anaesthesiology and Intensive Care during the study period. The number of the different types of artificial pulmonary ventilation delivered during the survey period 2010-2015 is presented in Table 13 and Figure 1.

Table 13: Nosocomial infections in patients in artificial pulmonary ventilation

Nosocomial infections (NI)	Number of artificial pulmonary ventilations	Percent of the total number of artificial pulmonary ventilations
RANI	187	20%
CANI	275	29%
CAUTNI	356	37%
SSNI	135	14%
Total number of NI	953	

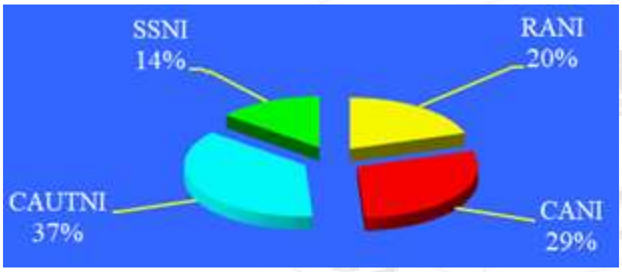

Figure 1: Nosocomial infections

RANI – respiratory associated nosocomial infections
CANI – catheter associated nosocomial infections
CAUTNI – catheter associated urinary tract nosocomial infections
SSNI - surgical site nosocomial infections

In Table 13 and Figure 1 it can be seen that the percentage of Nosocomial infections is the highest for CAUTNI group, followed by CANI group. Last are Nosocomial infections as a result of surgical intervention. The value obtained for RANI is 20%.

The number of different types of NI obtained during the survey period is presented in Table 14 and Figure 2.

Table 14: Nosocomial infections from 2010 to 2015

Years	*RANI*	*CANI*	*CAUTNI*	*SSNI*	*TOTAL*
2010	35	52	63	26	176
2011	33	51	59	24	167
2012	30	49	58	25	153
2013	32	40	67	23	162
2014	31	42	58	18	149
2015	26	41	60	19	146
Total number	187	275	356	135	953

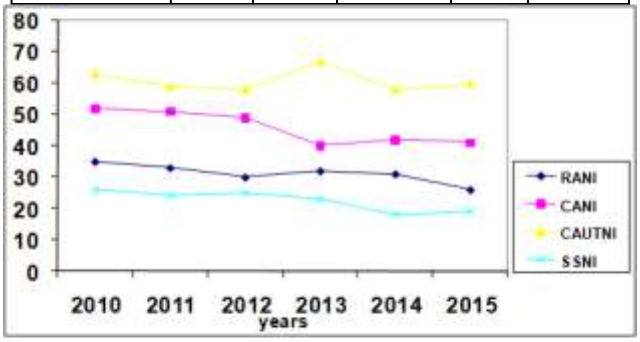

Figure 2: Nosocomial infections during the period 2010-2015

In Table 14 and Figure 2 it can be seen that during the first years of the survey, the values obtained for the different Nosocomial infections are the highest. For 2010, the number of RANI is also the highest but it tends to decrease in the following years. For all Nosocomial infections in the pointed period, a strong tendency is observed for reducing their emergence and progress in the clinic over the last years of the survey.

In patients with Chronic obstructive pulmonary disease (COPD), the following types of Nosocomial infections are determined:

- RANI in 48 patients;
- CANI in 35 patients;
- CAUTNI in 38 patients;
- SSNI in 12 patients.

The microbiological profile of Gram (-) microorganisms and Fungi which are responsible for Nosocomial infections is presented in Figure 3.

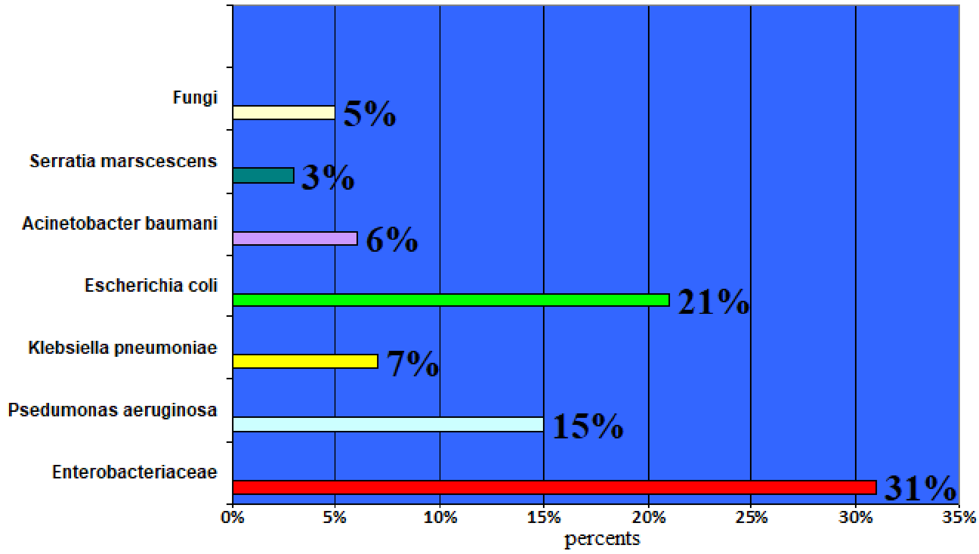

Figure 3: Microbiological profile of Gram (-) microbes and Fungi

In Figure 3 it is found that in the case of Gram (-) microbes, the percentage of microorganisms from the Enterobacteriaceae group is the highest - 31%, followed by Pseudomonas aeruginosa - 15%, Klebsiela pneumonia - 7%, Acinetibacter baumani - 6%. Fungi are represented mainly by Candida albicans with 5%. In 6% of the patients the presence is found of Acinetobacter baumani. Despite of the low rate of Serratia marcescens - 3%, in these patients higher number of Nosocomial infections is recorded later.

The microbiological profile of Gram (+) microbes responsible for Nosocomial infections is presented in Figure 4.

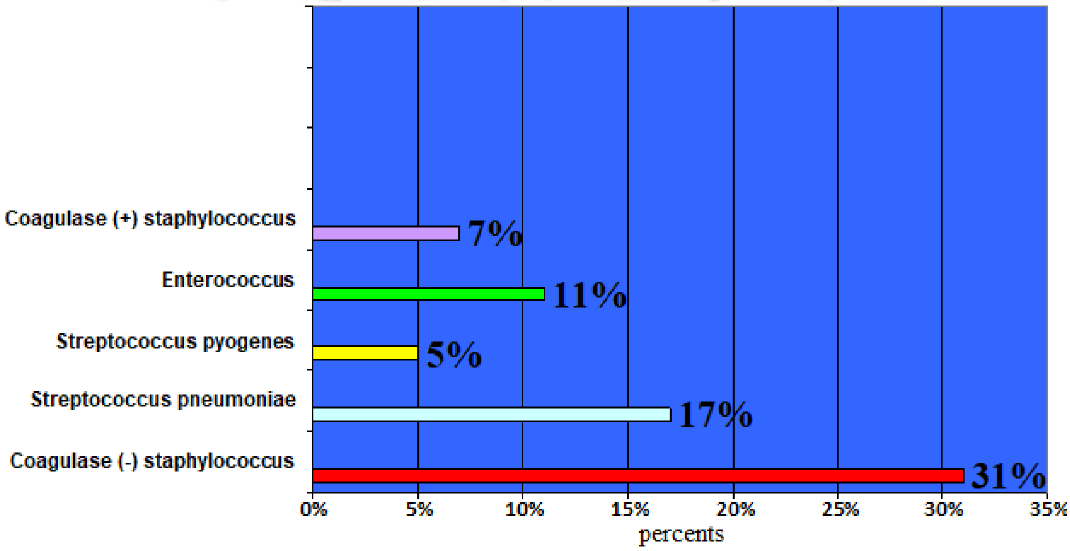

Figure 4: Microbiological profile of Gram (+) microbes

In Gram (+) microbes, the percentage is the highest of Coagulase (-) Staphylococcus - 31%, Escherichia coli - 17%, Streptococcus pneumoniae - 12% and Enterococcus - 11%. Methicillin resistant Staphylococcus aureus (MRSA) and methicillin sensitive staphylococcus aureus (MSSA) represent 7% of the nosocomial infections.

The allocation of central venous catheters (CVC) placed according to the etiological reason which necessitate artificial pulmonary ventilation is presented in Table 15.

Table 15: Allocation of central venous catheters (CVC)

CVC	Total	Multiple trauma	Isolated cranial brain trauma	Postoperative Respiratory failure	Thoracic trauma	Infections of the lung	Infections with genital origin	Others
V. Jugularis int.	396	170	30	43	52	32	49	20
V. Subclavia	147	71	9	30	7	17	11	2
V. Femoralis	69	26	5	9	8	14	5	2
Total	612	267	44	82	67	63	65	24

In Table 15 it can be seen that the highest is the number of the central venous catheters (CVC) placed on V. Jugularis int. dex. or sin., followed by those on V. Subclavia dex. or sin., and the lowest is the number of catheters placed on V. Femoralis dex. or sin.

Table 16 presents the frequency of CVC infections depending on the catheterized vein.

Table 16: Frequency of CVC infections depending on the catheterized vein

Place of CVC	Number of CVCs placed	Local infection (% of the total number of CVC)	Colonization (% of the total number of CVC)	CANI (% of the total number of CVC)
V. Jugularis	396	91 (15%)	136 (22%)	137 (22%)
V. Subclavia	147	37 (6%)	59 (10%)	107 (17%)
V. Femoralis	69	19 (3%)	28 (4%)	31 (6%)
Total number	612	147 (24%)	223 (36%)	275 (45%)

The results obtained for the frequency of CVC infections depending on the catheterized vein indicate that the percentage of CANI is the highest in patients with CVC placed through V. Jugularis int. dex. or sin. (22%). It is also found in them a high rate of colonization (22%) and local infection data (15%). Secondly, CVC infections are reported after cannulation of V. Subclavia dex. or sin (17%). KANI caused after insertion of a central catheter in V. Femoralis dex. or sin. takes the third place (6%).

The correlation between the duration of the catheters stay and the origin of CVC infections is presented in Table 17 and Figure 5.

Table 17: Frequency of CVC infections depending on the duration of hospital stay

Stay (in days)	Local infection (number and % of the total number of CANI)	Colonization (number and % of the total number of CANI)	CANI (number and % of the total number of CANI)
< 7 days	30 (11%)	35 (13%)	69 (25%)
7 – 14 days	63 (22%)	98 (36%)	127 (46%)
> 14 days	54 (20%)	90 (33%)	79 (29%)
Total number	147 (53%)	223 (81%)	275

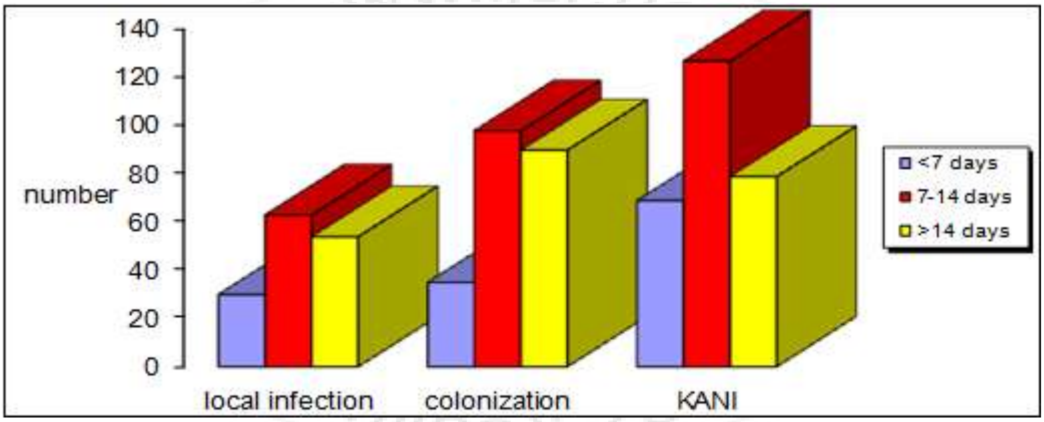

Figure 5: CVC infections' frequency depending on the duration of stay of the catheters

The data obtained from the Table 17 and Figure 5 indicates that the frequency of the studied forms of CVC infections, depending on the duration of stay of the catheters, is the highest with the catheters placed between 7 and 14 days. This trend is the best revealed in the generalized form of this type of infection, such as CANI. It has the highest values during this period. In the following period CANI tend to decrease. The number of the local infections and the colonization between 7 and 14 days from the treatment process is also the highest.

The microbiological profile of CANI is presented in Figure 6.

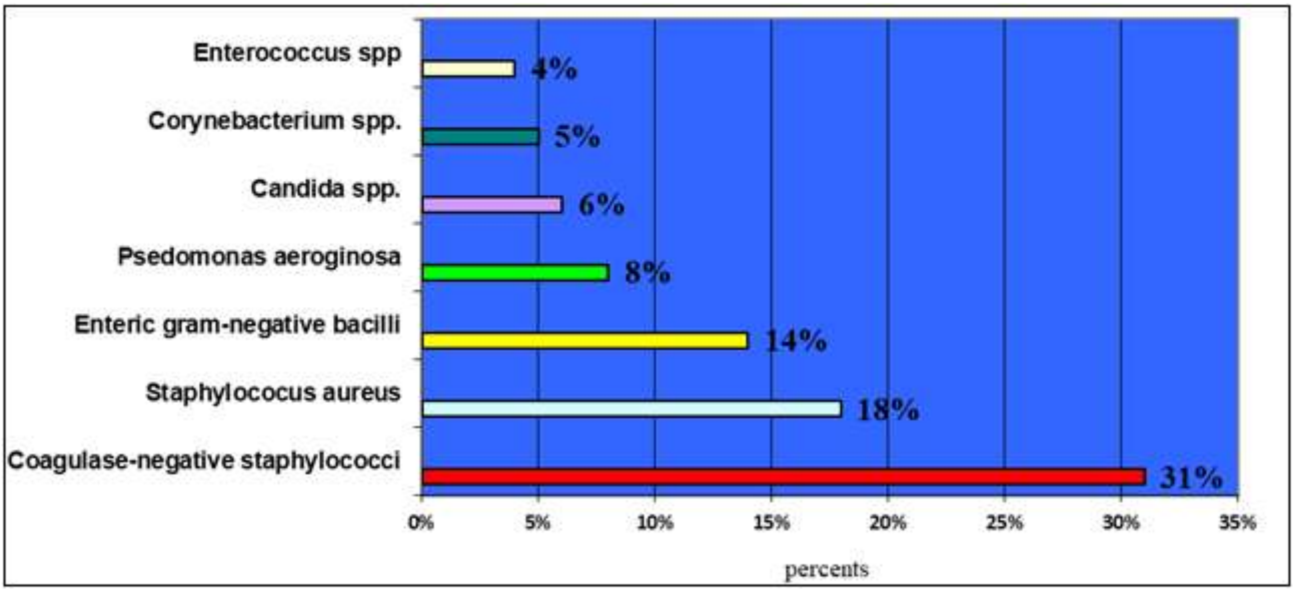

Figure 6: Microbiological profile of CANI

In Figure 6 it can be seen that the microorganisms from the Coagulase-negative staphylococci group are the most risky for the occurrence and progress of CANI. Second is Staphylococcus aureus with 18% and third is Enteric gram (-) bacilli.

The incidence of CAUTNI by duration of urethral catheterization up to 7 days and more than 7 days from the beginning of the treatment process is presented in Table 18.

Table 18: Number of CAUTNI

Group	Up to 7 days	More than 7 days	CAUTNI
Total number	125	231	356

The microbiological profile of CAUTNI is presented in Figure 7.

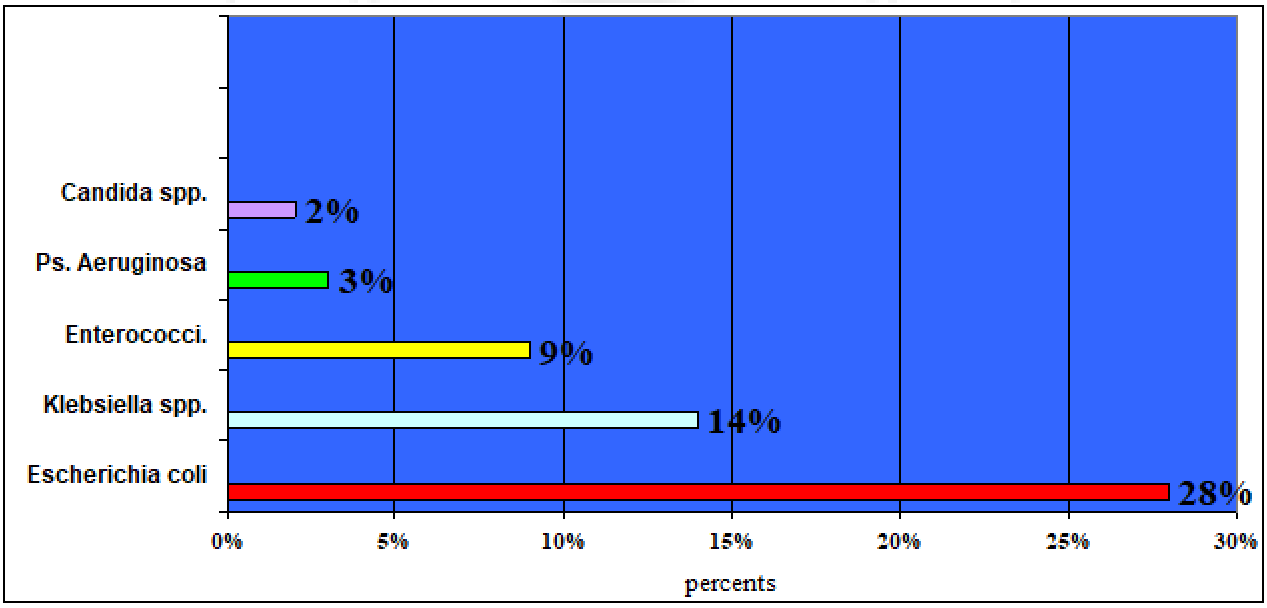

Figure 7: Microbiological profile of CAUTNI

In Figure 7 it can be seen that the percentage is the highest of **CAUTNI** caused by Escherichia coli - 28%, Klebsiella spp. - 14% and thirdly - Enterococci by 9%. 3% of patients have also Ps. aeruginosa.

The incidence of SSNI up to 7 days and more than 7 days from the beginning of the treatment process is presented in Table 19.

Table 19: Frequency of SSNI depending on the duration of the hospital stay

Groups	Local infection (number and % of the total number of SSNI) < 48 hours > 7 days	SSNI (number and % of the total number of SSNI)
Total number	74 (51%) 71 (49%)	145

The microbiological profile of SSNI is presented in Figure 8.

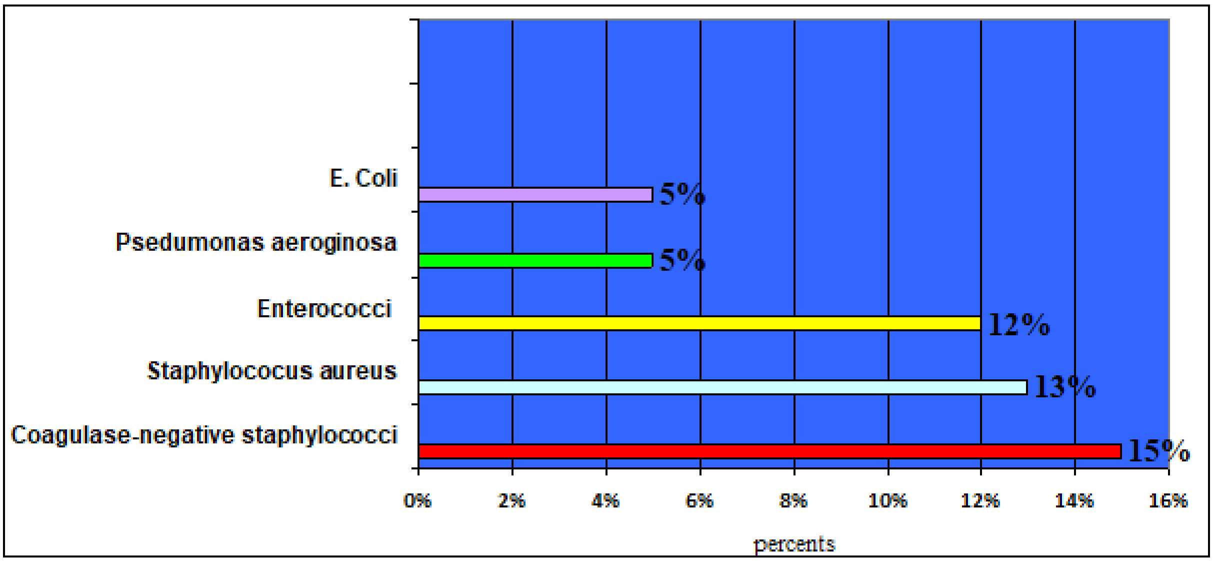

Figure 8: Microbiological profile of SSNI

In Figure 8 it can be seen that the highest is the percentage of SSNI caused by Coagulase-negative staphylococci - 15%, Staphylococcus aureus - 13% and thirdly - Enterococci by 12%.

4. Conclusions

During the studied years a presence of microorganisms is found in the Clinic for Anaesthesiology and Intensive Care which can be detected in patients' organisms at a given moment. Such bacteria, also known in other intensive care structures and found in patients, are:

a) **Coagulase-negative staphylococci**
Determined as major microorganisms in the microbiological profile of catheter associated and surgical nosocomial infections
b) **Staphylococcus aureus**
Secondly determined as major microorganism in the microbiological profile of catheter associated and surgical nosocomial infections
c) Enterococci
Thirdly determined as major microorganism in the microbiological profile of catheter associated and surgical nosocomial infections
d) Escherichia coli
Determined as a major microorganism in the microbiological profile of catheter associated urinary nosocomial infections
e) Klebsiella pneumoniae
Secondly determined as microorganism in the microbiological profile of the catheter associated urinary nosocomial infections

Nosocomial infections are frequent complications in the treatment of patients in intensive care structures. Sometimes they become a turning point in seriously progressing diseases. Unspecified diagnostic criteria and variations in patients' demographic characteristics make it impossible to precisely determine the frequency of Nosocomial infections, but it is considered that it progresses in ¼ to ½ of the patients who have undergone intensive care units. However, the infections caused in ICU are not frequent complications, but they rather progress in the most injured patients. It is considered that Nosocomial infections are not so much the reason for increased morbidity rate, but they rather reflect the clinical condition of the patients.

Diagnosing, monitoring and treatment of infectious complications in the Clinic for Anaesthesiology and Intensive Care are a challenge for the staff working there. The infectious process that occurs in these structures can be diagnosed primarily in the same these structures, as the methods used to diagnose and determine the seriousness of the infections is applied there as well as the methods for control, correcting and treating of disorders in the vitally important organs and functions of the human organism.

There are many factors that influence the spread of microbes in the human organism in patients in artificial pulmonary ventilation. The most researchers point out the most important ones according to them. The differences between the separate authors are due to:

- The nature of the study
- the types of intensive structures
- the patients contingent
- the type of the treatment process performed
- the national characteristics typical for certain nations

Bacterial monitoring facilitates the early recognition of colonization and infections and it is connected with a statistically significant reduction of Nosocomial infections. The local infectious control in ICU includes a follow up system and maintenance database for the endemic values of individual microbes typical for a definite structure. Prevention of Nosocomial infections by means of changing the risk for the patients includes activities related to the treatment of concomitant diseases and their complications and control of antibiotic use. The adoption of antibiotic policy which does not admit the use of broad spectrum antibiotics and useless patent medicines right in the beginning of the treatment process is of utmost importance.

It should not be forgotten about the impact of the design of intensive care units, which has a direct effect on the progress of Nosocomial infections. Sufficient space, lighting, good ventilation and handwashing devices reduce the incidence of infections. The improvement of the environment itself cannot reduce the infectious process if the conduct of the staff does not improve. In ICU the staff is the most important factor - its number, quality, motivation of the doctors, nurses and hospital attendants. The staff should involve sufficient number of nurses so that they do not have to move from patient to patient and work under constant tension. The importance of keeping hygiene and aseptic in everyday work should be emphasized. It has been proved that careful monitoring, decontamination and compliance with the instructions for use of respiratory equipment reduce the frequency of Nosocomial infections and, in particular, of RANI. Hand washing and disinfection with alcohol disinfectants is one of the most important measures for infections control.

Since the artificial pulmonary ventilation is a risk factor for the progress of Nosocomial infections, reducing its duration can itself lead to a significant reduction of the infectious process in these patients. Optimizing of protocols for the earliest termination of artificial pulmonary ventilation is probably one of the first steps for reducing the infectious morbidity.

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