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NASOPHARYNX MICROFLORA FEATURES AND ITS ROLE IN THE SPREAD OF NOSOCOMIAL INFECTION

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Summary

Introduction. The threat of the spread of nosocomial infection is exacerbated by a number of factors, among which we should note the increase in the number of multidisciplinary medical institutions of various forms of ownership, the creation of new types of medical instruments, devices, medical drugs, the introduction of new kinds of invasive (instrumental) diagnostic and therapeutic interventions, the increase in the number of patients with suppressed immunity (premature newborns, patients with chronic diseases of various origins, elderly people). The source of nosocomial infection can be patients, medical personnel, visitors, and objects of the hospital environment: tools, linen, furniture, air, and food. The main ways of transmission of nosocomial infections are aerosol (air-droplet, air-dust), contact (through tools, linen, furniture), parenteral (when administering drugs), fecal-oral (dirty hands), alimentary (through food).

Aim: to investigate the microflora of the nasopharynx of visitors to medical and preventive care institutions, to reveal the prevalence of carriers of pathogenic strains. The role of visitors to hospital patients in the spread of nosocomial infections is an extremely relevant topic, as it is insufficiently studied and requires in-depth research.

Materials and methods. 40 visitors to medical and preventive care institutions (MPCI) who had no signs of respiratory tract diseases and exacerbations of comorbid pathologies were examined.

All the studied visitors of MPCI patients were divided into 3 age groups according to WHO recommendations:

1st group (n=15) – young patients (18-44 years old);

2nd group (n=14) – middle-aged patients (44-60 years old);

The 3rd group (n=11) – elderly patients (60-75 years old).

Compliance of the distribution of clinical trial data with the law of normal distribution was checked using the Shapiro–Wilk test. Arithmetic means to value and standard error ($M \pm m$) were used to describe the data. The concentration of bacteria in the sample was presented as a decimal logarithm.

The results. Bacteriogram indicators of the mucous membrane of the back wall of the nasopharynx were analyzed in visitors to the MPCI patients in different age groups. Statistically significant differences were found in the concentration of representatives of the studied bacteriogram ($p < 0.05$), which indicates the influence of age on the composition of the microflora of the mucous membrane of the back wall of the nasopharynx. A statistically significant difference was established in the concentration and composition of representatives of the bacteriogram of the mucous membrane of the back wall of the nasopharynx in visitors to the MPCI patients of different age groups ($p < 0.05$), which indicates the dependence of the composition of the microflora of the nasopharynx on age. A statistically significantly higher concentration of *Staphylococcus aureus* was found in the group of young patients ($p < 0.05$), which indicates the release of the most significant amount of this pathogen from the carriers of this group and an increase in the probability of developing infectious complications when in contact with visitors to the hospital, who were included in the added group, in comparison with other studied groups.

Conclusion. Asymptomatic carriers of pathogenic strains of bacteria were found in all studied age groups of visitors to the hospital, which suggests the possibility that the studied patients may be a potential source of hospital infection in hospital patients, but this requires further research.

Keywords: nasopharyngeal microflora, nosocomial infection.

The problem of nosocomial infections has gained considerable relevance in recent years. nosocomial infections lead to prolongation of the treatment period, chronicity of the process, disability, and in the most severe cases — the death of the patient [1,2].

The threat of the spread of nosocomial infections is exacerbated by a number of factors, among which we should note the increase in the number of multidisciplinary medical institutions of various forms of ownership, the creation of new types of medical instruments, devices, medical drugs, the introduction of new kinds of invasive (instrumental) diagnostic and therapeutic interventions, the increase in the number of patients with depressed immunity (premature newborns, patients with chronic diseases of various origins, elderly people) [1,2].

The source of nosocomial infections can be patients, medical personnel, visitors, and objects of the hospital environment: instruments, linen, furniture, air, and food. The main ways of transmission of nosocomial infections are aerosol (air-droplet, air-dust), contact (through tools, linen, furniture), parenteral (when administering drugs), fecal-oral (dirty hands), alimentary (through food) [1,2].

The fight against nosocomial infections is a complex and time-consuming process, primarily because pathogens, as a rule, circulate widely enough in the hospital environment, and have high resistance to external influences (antibiotics, antiseptics, disinfectants) and various transmission mechanisms. There are bacteria against which there are practically no effective antibiotics left today: resistant to carbapenems (*Pseudomonas aeruginosa*, *Acinetobacter* spp, *Klebsiella pneumoniae*, etc.); methicillin-resistant (*Staphylococcus aureus*, *Staphylococcus epidermidis*, etc.) [2,3].

The consequences of the action of antibiotic-resistant bacteria, the causative agents of nosocomial infections, are extraordinary. In the United States, more people die from infections caused by resistant staphylococcus (MRSA) than from AIDS. In European countries, about 5 million cases of infections associated with the provision of medical care are registered annually (46-93 per 1,000 hospitalizations). In particular, in Germany, nosocomial infections are detected in approximately 3.5% of patients, in France - in 7.6%, Sweden and Great Britain - in about 7 and 10%, respectively. According to WHO experts, in developing countries, this indicator in some cases exceeds 40% [1-5].

The role of visitors to hospital patients in the spread of nosocomial infections is an extremely relevant topic, as it is insufficiently studied and requires in-depth research.

Aim: to investigate the microflora of the nasopharynx of visitors to medical and preventive care facilities, to reveal the prevalence of carriers of pathogenic strains.

Materials and methods. We examined 40 visitors to the MPC patients, who had no signs of respiratory tract diseases and exacerbations of comorbid pathologies. Exclusion criteria were oncological diseases, acute, and exacerbation of chronic pathologies of vital organs, severe diabetes mellitus, and type 1 diabetes mellitus. The average age of the patients was (44.50±18.83) years (from 20 to 75 years); there were 19 (47.50%) women and 21 (52.50%) men.

All patients were swabbed from the mucous membrane of the back wall of the nasopharynx with a sterile disposable swab. For 4-5 hours before the time of material collection, no nasal drops were used, and the nasal passages were not washed. The material was collected on an empty stomach or 3-4 hours after consuming food and drinks. During the 14 days before sampling, the use of antibacterial, antifungal, and immunobiological drugs was excluded.

Determination of the qualitative and quantitative composition of the microflora of the nasopharynx was carried out by the bacteriological method, by determining the morphological, tinctorial, and biochemical properties of bacteria.

All the studied visitors of MPC patients were divided into 3 age groups according to WHO recommendations:

1st group (n=15) – young patients (18-44 years old);

2nd group (n=14) – middle-aged patients (44-60 years old);

The 3rd group (n=11) – elderly patients (60-75 years old).

Compliance of the distribution of clinical trial data with the law of normal distribution was checked using the Shapiro–Wilk test. Arithmetic means to value and standard error ($M \pm m$) were used to describe the data. The concentration of bacteria in the sample was presented as a decimal logarithm. When testing statistical hypotheses, the null hypothesis was rejected at a level of statistical significance (p) less than 0.05. Non-parametric tests were used for populations whose distribution differed from "normal": to compare two independent samples, the Mann-Whitney U-test was used. The presence and probability of differences between sample means of independent samples were assessed using One-way ANOVA followed by post-hoc Tukey HSD (Honestly Significant Difference) test. The software-mathematical complex for a personal computer "Microsoft Excel 2016" (Microsoft) and computer programs for

statistical analysis and data processing "STATISTICA ® 8.0" (StatSoft Inc., USA) and IBM ® SPSS ® Statistics Version 16.0 were used.

The results. Bacteriogram indicators of the mucous membrane of the back wall of the nasopharynx were analyzed in visitors to the MPCCI patients in different age groups. Statistically significant differences were found in the concentration of representatives of the studied bacteriogram ($p < 0.05$), which indicates the influence of age on the composition of the microflora of the mucous membrane of the back wall of the nasopharynx (Table 1).

The lowest concentration of *Staphylococcus* spp. was found to be statistically significant in the 1st group of young people compared to other studied groups ($p < 0.05$). However, in the 1st group of young people, the highest concentration of *Staphylococcus aureus* was found ($p < 0.05$), which indicates the release of the largest amount of this pathogen from the carriers of this group and an increase in the probability of developing infectious complications when in contact with visitors to the hospital, who entered the 1st group, in comparison with other studied groups. Also, the lowest concentration of *Corynebacterium* spp. in persons of the 3rd group ($p < 0.05$). An insignificant statistically significant concentration of *Streptococcus pneumonia* was detected in persons of the 2nd group ($p < 0.05$). The presence of a statistically significant concentration of *Streptococcus pyogenes* ($p < 0.05$) was established in the visitors of the 3rd group. A statistically insignificant concentration of *E.coli* was also found in the 3rd group of hospital visitors ($p < 0.05$) (Table 1).

Table 1 – Indicators of the bacteriogram of the mucous membrane of the back wall of the nasopharynx

Indicator	All subjects	1st group	2nd group	3rd group
<i>Staphylococcus</i> spp., lg CFU/ml	1.27±0.23	0.85±0.27*#	1.52±0.44#	1.51±0.53#
<i>Staphylococcus aureus</i> , lg CFU/ml	0.96±0.19	1.21±0.29*#	0.72±0.32	0.94±0.40
<i>Corynebacterium</i> spp., lg CFU/ml	0.80±0.20	0.85±0.34	0.95±0.36#	0.55±0.36*#
<i>Streptococcus pneumonia</i> , lg CFU/ml	0.10±0.07	0.00±0.00	0.28±0.19*#	0.00±0.00
<i>Streptococcus pyogenes</i> , lg CFU/ml	0.07±0.07	0.00±0.00	0.00±0.00	0.25±0.25*#
<i>E.coli</i> , lg CFU/ml	0.03±0.03	0.00±0.00	0.07±0.07*#	0.00±0.00

Note: * - statistically significant difference compared to other studied groups according to the One-way ANOVA test followed by post-hoc Tukey HSD ($p < 0.05$);
- a statistically significant difference in relation to the cohort of all subjects according to the Mann-Whitney U-test ($p < 0.05$).

In comparison with the cohort of all the studied visitors of the MPCCI patients, statistical differences were found in the observation groups, which were divided by age ($p < 0.05$). A statistically significantly lower level of *Staphylococcus* spp. in the 1st group compared to the cohort of all visitors to the hospital ($p < 0.05$), in the 2nd and 3rd groups the concentration of *Staphylococcus* spp. was statistically significantly higher in comparison with the cohort of all visiting patients of the MPCCI ($p < 0.05$). A statistically significantly higher concentration of *Staphylococcus aureus* was found in the 1st group compared to the cohort of all studied visitors to the hospital ($p < 0.05$). A statistically significantly higher concentration of *Corynebacterium* spp. in the 2nd group of subjects in comparison with the cohort of all studied visitors to the MPCCI ($p < 0.05$), and in the 3rd group, the concentration of these bacteria was statistically significantly the lowest ($p < 0.05$). Since *Streptococcus pneumonia* and *E.coli* were detected in the visitors of the 2nd group of MPCCI patients and a statistically significant difference was found in the concentration of these pathogens in the studied group in comparison with the cohort of all studied visitors of the MPCCI patients ($p < 0.05$). In the 3rd group, a statistically significantly higher concentration of *Streptococcus pyogenes* was observed in comparison with the cohort of all studied visitors to the MPCCI patients ($p < 0.05$), since the carrier of this pathogen was detected precisely in this studied age group of visitors to the MPCCI patients (Table 1).

Discussion. Since the nasopharynx occupies an intermediate place between the nose, sinuses, ears, larynx, and the lower respiratory tract, the resident microflora can be a source of diseases in both the upper and lower respiratory tracts. Active reproduction of microorganisms occurs especially during acute respiratory viral infections. Under the influence of infection and other factors that suppress immunity, the bacterial process develops in normally sterile parts of the respiratory tract - in the middle ear, paranasal sinuses, and lungs. Bacterial pathogens can also enter the bloodstream and cause invasive diseases, such as bacteremia, hematogenous pneumonia, and meningitis [6]. The microflora of the nasopharynx plays an important role not only in the development of endogenous infections but also occupies an important place in the spread of pathogenic strains of microorganisms transmitted by airborne droplets. Special attention is drawn to the importance of asymptomatic carriers of pathogenic strains [7]. The role of pathogenic

representatives of the microflora of the nasopharynx of visitors to hospital patients has not been sufficiently investigated and requires further study.

Conclusions:

1. A statistically significant difference was established in the concentration and composition of representatives of the bacteriogram of the mucous membrane of the back wall of the nasopharynx in visitors to the MPCI patients of different age groups ($p < 0.05$), which indicates the dependence of the composition of the microflora of the nasopharynx on age.

2. A statistically significantly higher concentration of *Staphylococcus aureus* was found in the group of young patients ($p < 0.05$), which indicates the isolation of the most significant amount of this pathogen from the carriers of this group and an increase in the probability of developing infectious complications when in contact with visitors to the hospital, who entered the added groups, in comparison with other studied groups.

3. Asymptomatic carriage of pathogenic bacterial strains were established in all studied age groups of visitors to the hospital, which indicates the possibility that the studied patients may be a potential source of the development of hospital infection in patients of the hospital, however, this requires further research.

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