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K.A. Nurlybayeva, A.M. Aitkulov, M.A. Mukasheva, A.E. Starikova

Ye.A. Buketov Karaganda State University, Kazakhstan
(E-mail: kunduz09@mail.ru)

Cytomorphological assessment of the nasal mucosa of the children's population of some industrial cities of Karaganda region

The article presents the results of studying rhinocytogram of the child population of three industrial cities of Karaganda region (Temirtau, Balkhash, Abai cities). The methods of cytological analyses of mucous membrane of the nasal cavity (MMNC) were used. Cytochemical methods were used for early detection of functional changes in the non-specific mononuclear system of protection of an organism from environmental factors. In the cytomorphologycal study of MMNC's cell, it was found a reduced quantity of normal epithelial cells of children which live in Temirtau city (10.8 times) and in Balkhash city (12.1 times).. Students of Abai city had the 13.3 times decrease of indicators in the cells of flat epithelium. The number of segmental and rod-core neutrophils with signs of damage exceeded the physiological norms in the children's population of Abai (4.8 times), Temirtau (6.3 times), and Balkhash (7.4 times). Thus, with the help of indicators of bacterial contamination of the mucous membranes of the nasal cavity, it is possible to identify people who are at risk for non-specific diseases and have suppressed function of immune system.

Keywords: mucous membrane of the nasal cavity, children's population, nonspecific resistance of an organism, eosinophils, mast cells.

Introduction

Recently, it has become possible to introduce new methods of analysis in environmental and biological monitoring [1–3]. According to scientific publications [2, 4, 5] the oral and nasal microflora is an integral indicator of the organism's state that are influenced by the multifactorial effects of the environment and reflects the violation of neuro-humoral regulation in the body as the result of any disease. Increasing the number of cells with karyorhexis is the result of apoptosis that is characterized by proliferative activity of cells by the action of endogenous or exogenous factors. An increase of the quantity of nuclear-free cells characterizes the ulcerative-inflammatory process, which leads to hyperkeratosis, and with an increase in the number of neutrophils (NP) develops an inflammatory-infectious process [6]. An increase of the number of binuclear cells indicates initial mutagenic activity [7, 8]. The formation of vacuole dystrophy indicates cell degeneration and that is one of the signs of necrosis; and the increase of quantity of cells with vacuoles is served as an indicator of toxic effects [9]. An increase of the number of mast cells (MC) indicates intoxication in which the accumulation of granular MC occurs first, and then they actively secrete biologically active substances, causing a violation of the reactivity of buccal cheek epithelium [10, 11]. Thus MC enhances collagen synthesis by fibroblasts, fibrous formation and activity of mastocytes (degree of degranulation) becomes maximal. The experience of the above-mentioned numerous studies of the MMNC showed undoubted interest and perceptivity for further research in that direction.

Methodology

We have organized and conducted research work of children's contingent of primary classes (1st and 2nd grades) of secondary educational schools of Temirtau, Balkhash and Abai cities of Karaganda region. In total, we examined 240 children 6–8 years old.

To survey the child population of the three industrial cities of the Karaganda region with the methods of cytological analyses of mucous membrane of the nasal cavity (MMNC) are used with microscope MS-200 (Austria, 2004). Normality of data distribution is estimated by Kolmogorov-Smirnov criterion. The time allotted for each phase of the study: warm-up, calibration, testing sensors, etc were taken into account to exclude systematic errors type of «test – observation». The arithmetic mean, variance, error were calculated for quantitative variables with normal distribution. The median the 95 % confidence interval (CI) were calculated for quantitative variables that do not obey the norms distributing. The differences between the groups were revealed by the methods of parametric statistics. Comparison and evaluation of relative risks was performed according to the value of χ^2. Nonparametric criteria based on univariate dispersion analysis based on Wilcoxon rank labels, median test, Spearman rank correlation coefficient were used for calculation [12–15]. The modifier of the research was the purity of the using reagents, which were controlled by standard solutions «control – quality». The results of the deviation, changes in the rhinocytogram, fluctuations were compared with the physiological limits of the fluctuations.

Specific criteria for rhinitis and induced mutagenesis were used according to the indicators of MMCN. We counted 200 cells. If 40–50 % of neutrophils (NL) were observed, the condition was recorded as acute inflammatory rhinitis. If 5 % of normal cubic cells and more than 30 % of damaged cubic cells with destroyed neutrophils were found, this condition was recorded as chronic atrophic rhinitis. 5 % and above of eosinophils and MC indicated the state of allergic rhinitis. 50 % or above of degenerated neutrophilic leukocytes (DNL) was characteristic of chronic inflammatory rhinitis. Less than 5–10 % of flat epithelial cells, and more than 40 % of degenerated flat epithelial cells (FEC) were characteristic of catarrhal rhinitis. 50 % or more detected FEK, degenerated cubic and cylindrical cells (DCC), DNL, MK – subatrophic rhinitis.

Results and their discussion

According to the results of our own cytomorphological studies of MMNC cells, it was found that the number of normal epithelial cells of children of Temirtau was reduced 10.8 times, Balkhash — 12.1 times. Abai schoolchildren's level of flat epithelial cells decline 13.3 times (Table 1).

Table 1

Quantity (in %) of flat epithelium cells of MMNC in children (6–8 years old) (M±m, 95 % CI)

Cell type	Norm	Abai (n=80)	Balkhash (n=80)	Temirtau (n=80)
Without signs of damage	40.00±3.40 (10–70)	3.0±1.0* (1.3–7.3)	3.3±1.8* (4.6–11.3)	3.7±1.1* (0.8–6.5)
With signs of damage	2.00±0.03 (0–4)	36.3±6.1* (23.3–49.2)	55.0±7.6* (38.8–71.1)	43.3±7.2* (28.0–58.5)

Note. * — $p < 0.05$.

Flat epithelial cells with signs of damage were found in the mucous membrane of the nasal cavity in all surveyed children of the cities of Karaganda region. Excess with signs of damage of children's flat epithelium of MMNC was recorded at values 18.1 times in Abai, 27.5 times in Balkhash, 21.65 times in Temirtau. Research data [2, 4, 9, 10, 16, 17] are shown that the MMNC reflects the state of an organism that changes depending on environmental pollution. Epithelial cells of mucous membranes of various degrees of differentiation, which are in certain stable relations with each other, changes under the influence of various adverse effects and can be considered as a target [18, 19].

The similar situation is observed in relation to normal cubic and cylindrical epithelial cells in Temirtau, The quantity of these cells was reduced 17.3 times in children living in Temirtau, 6.4 times — in Balkhash, 3.38 times — in Abai (Table 2). The number of cubic and cylindrical epithelial cells with signs of damage of Temirtau children increased slightly by 40 %, Balkhash children — 2.7 times.

Our results are consistent with those of other researchers [4, 9, 18, 20]. Dust, gases, general toxic action substances entering the organism from atmospheric air cause polymorphic changes in MMCN. The greatest changes are observed in acute and chronic rhinitis. In the results of our research, children showed the decrease in the cleaning ability of the epithelium of the upper respiratory tract. We noted the increase of impact on phagocytic cells, that type of cells become less functionally and they are able to deposit in epithelium of respiratory tract. Some cells penetrate to the basal layer and become a trigger for the development of early

alteration of the epithelium, neutrophils, macrophages. Disorder of their functional properties increases simultaneously with functional insufficiency of muco ciliary clearance [18, 20].

Table 2

Quantity (in %) of cubic and cylindrical epithelial cells of children MMCN (6–8 years old) (M±m, 95 % CI)

Cell type	Norm	Abai (n=80)	Balkhash (n=80)	Temirtau (n=80)
Without signs of damage	45.00±4.20 (15–75)	13.3±10.9 (21.5–48.0)	7.0±4.1* (4.4–18.4)	2.6±1.1* (0.5–5.7)
With signs of damage	5.00±1.20 (0–10)	13.2±3.2* (6.1–20.3)	13.6±2.8 (7.6–19.5)	7±1.4 (3.8–10.1)

Note. * — $p < 0.05$.

To determine the influence of harmful environmental factors on the health status of schoolchildren as indicators that reflect protective-adaptive reactions of an organism, we used the rhinocytogram with the study of the quantitative characteristics of segmental and rod-core neutrophils (Table 3). The analysis of the results revealed that the number of segmental and rod-core NL exceeds the norm 11.5 times in rhinocytogram of children living in Abai; in Temirtau — 11.3 times and in Balkhash — 12.1 times. It was detected that elevation of segmental and rod-core neutrophils with signs of damage 4.8 times in Abai; 6.3 times in Temirtau, and 7.4 times of Balkhash.

Table 3

Segmental and rod-core neutrophils (in %) of MMCN in children (6–8 years) (M ± m, 95 % CI)

Cell type	Norm	Abai (n=80)	Balkhash (n=80)	Temirtau (n=80)
Without signs of damage	2,00±0,90 (1–3)	23,0±10,4 (3,8–49,8)	24,3±4,9* (13,0–35,6)	22,7±5,7* (10,1–35,2)
With signs of damage	5,70±0,50 (1,4–10)	27,8±5,7* (15,2–40,3)	42,3±5,0* (31,5–52,9)	36,3±5,4* (26,7–61,9)

Note. * — $p < 0.05$.

As can be seen from Table 4, the contamination by microflora (Streptococcus and Staphylococcus) is increased in the children's contingent of Balkhash city 10.75 times; 4.1 times in Temirtau and 3 times in Abai. In areas with adverse hygienic situation children are more often ill with diseases of the ENT organs, skin, allergies. These diseases are detected 3 times more often than in control groups of children. Herewith there is the certain predominance of ENT diseases in children who live in areas with air contaminated with phenol. Systematic dust exposure leads to the increase of the rhinitis, bronchitis incidence of children [18]. The air polluted by emissions of industrial production (hydrocarbons, hydrogen sulfide) causes allergies of children which live in the area more than 3 years.

Table 4

Contamination with microflora (in %) of MMCN of children (6–8 years) (M ± m, 95 % CI)

Cell type	Norm	Abai (n=80)	Balkhash (n=80)	Temirtau (n=80)
Eosinophils	0,30±0,01 (0,0–0,60)	13,0±9,0	–	–
Mast cells	1,20±0,01 (0,20–2,20)	–	–	–
Contamination with microflora (streptococci and staphylococci)	1,20±0,01 (0,0–2,40)	3,6±0,8* (1,1–6,0)	12,9±2,5* (7,3–18,5)	5,0±0*

Note. * — $p < 0.05$.

Conclusion

It is generally recognized that cytochemical methods can be used for early detection of functional changes in the nonspecific mononuclear system of organism's protection from environmental factors, depending on the impact of environmental stress [5, 9, 10, 16, 18]. The high sensitivity of these indicators of the organism's immune status allows recommending them for early detection of the impact of adverse environmental factors on humans. The most informative are data of bacterial contamination of the mucous membranes of the nasal cavity, which can be used to identify people who are at risk for non-specific diseases and have suppressed function of immune system.

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К.А. Нурлыбаева, А.М. Айткулов, М.А. Мукашева, А.Е. Старикова

Қарағанды облысындағы кейбір өнеркәсіптік қалалардағы балалардың мұрнының шырышты қабығы күйін цитоморфологиялық бағалау

Мақалада Қарағанды облысының үш өнеркәсіптік қалаларында тұратын балалардың (Теміртау, Балқаш, Абай) популяциясын зерттеу нәтижелері бойынша риноцитограмманың өзгерістері талқыланды, мұрын шырышты қабығының зерттеу цитологиялық талдау әдісі арқылы жүзеге асырылды. Цитохимиялық әдістер ағзаны қоршаған ортаның факторларынан қорғау үшін спецификалы емес мононуклеарлық жүйеде функционалдық өзгерістерді ерте анықтау үшін қолданды. МҚШҚ жасушаларының цитоморфологиялық зерттеуі кезінде Теміртауда балалардың қалыпты эпителий жасушаларының саны 10,8 есеге, Балқаш қаласы 12,1 есеге азайғандығы анықталды. Абай қаласы оқушыларының жасушалық эпителийінің 13,3 есе азаюы байқалды. Абайда тұратын балаларына зиян белгілері бар сегменттер мен нейтрофилдерді ұрып-соғу 4,8 еседен асады, Теміртауда — 6,3 есе, Балқаш қаласының балалары 7,4 еседен асады. Осылайша, мұрын қуысының шырышты қабаттарының бактериялық ластану көрсеткіштерін пайдаланып, иммундық жүйенің депрессиялық функциясы болып табылатын ерекше емес ауруларды дамыту қауіпі бар адамдарды анықтауға болады.

Кілт сөздер: мұрын шырышты қабығы, балалар популяциясы, ағзаға тән емес қарсылық, эозинофилдер, жуан жасушалар.

К.А. Нурлыбаева, А.М. Айткулов, М.А. Мукашева, А.Е. Старикова

Цитоморфологическая оценка слизистой оболочки полости носа у детского населения некоторых промышленных городов Карагандинской области

В статье рассмотрены изменения в риноцитограмме по результатам обследования детского населения трех промышленных городов Карагандинской области (Темиртау, Балхаша, Абая). Использовались методы цитологического анализа слизистой оболочки носовой полости (СОПН). Цитохимические методы были применены для раннего выявления функциональных изменений неспецифической мононуклеарной системы защиты организма от факторов окружающей среды. При цитоморфологическом исследовании клеток СОПН было выявлено, что у детей, проживающих в Темиртау, количество нормальных эпителиальных клеток снижено в 10,8 раза, у детей в Балхаше — в 12,1 раза. У школьников, проживающих в Абае, отмечается снижение показателей в клетках плоского эпителия в 13,3 раза. Число сегментных и палочкоядерных нейтрофилов с признаками повреждения превышало физиологические нормы у детского населения г. Абая в 4,8 раза, Темиртау — в 6,3 раза и Балхаша — в 7,4 раза. Таким образом, с помощью показателей бактериальной обсемененности слизистых оболочек полости носа можно выявить людей, входящих в группы риска развития неспецифических заболеваний, представляющих собой угнетенную функцию иммунной системы.

Ключевые слова: слизистая оболочка полости носа, детское население, неспецифическая резистентность организма, эозинофилы, тучные клетки.

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