PREVENTION OF PRE-NOSOLOGICAL DISORDERS IN RIVER TRANSPORT PERSONNEL

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Annotation. In order to prolong the professional longevity of river transport personnel, the prevention of occupational diseases is most effective at the preclinical stage. The aim of our study was to develop methods for the reduction of pre-nosological disorders and the prevention of vibration white finger and sensorineural hearing loss in river transport personnel. Comprehensive prevention has a positive effect on adaptation capabilities (the number of workers with satisfactory adaptation increased by 1,5-2,0 times), the state of immunoreactivity (activation of both specific and nonspecific links of cell-mediated immunity was noted, as well as stimulation of immune adaptation responses), improves psychoemotional state of employees, reduces the risk of developing occupational diseases.

Introduction. Medical activity should be oriented not towards fighting diseases, but preserving health, including occupational health [1-2]. The important direction of medical service is carrying out preventive events at the pre-nosoliogical stage (the predisease stage). It will increase a possibility to reduce disorders of functional systems and allow decreasing a risk of developing occupational diseases [1, 3].

Adaptation capabilities of the organism define prospects of transforming a pre-nosological state into a disease [4]. Supporting adaptation responses on a satisfactory level is the top priority task of medicine. Implementing events that accelerate the organism's adaptation is a condition of preserving the human's health [5-6].

The immune system is the first to react to various unfavorable factors of industrial environment [3, 7]. An issue of identifying and supporting the level of natural immunoreactivity of workers in conditions of interaction between unfavorable factors of industrial environment is of great significance [7].

The role of spa treatment in preventing occupational diseases among individuals who work in unsafe working conditions is especially important [8]. When planning preventive events for workers who contact general vibration and noise, it is reasonable to take into account the occupational hazard [9].

The aim of our study was to develop methods for the reduction of pre-nosological disorders and the prevention of vibration white finger and sensorineural hearing loss in river transport personnel.

Methods and organization. We observed 99 workers of the OJSC "Tomsk shipping company" who had occupational contact with general vibration (vibration acceleration is 60-76 dB, class of working conditions is 3.1) and noise (80-110 dBA, class of working conditions is 2) on working places. The observed patients had following occupations: ship drivers and engineers, the engine department (mechanic, electrical mechanic, engine mechanic, crane operator, steersman, skipper, assistant mechanic and chief mate). The examined workers did not have occupational diseases.

The basic complex for initial prevention of occupational diseases included massage and applications of sapropel clay on the collar zone, transcranial electric stimulation, circular shower and sauna with pool. We also added methods contributing for an increase of self-regulation (psychological training with biological feedback), preventive drug therapy, extremely high frequency therapy on the tragus area and area behind the ears, ultratone therapy with an ear electrode for workers with more than 10 years of experience and an increased risk of developing occupational diseases. 21 workers with experience of 10 years and less (main group M1) received the initial prevention treatment. 20 workers with the same experience were included into the comparison group (comparison group C1), in which they did not receive any treatment. The secondary prevention treatment (main group M2) was carried out for 38 workers with the experience of more than 10 years. 20 workers with the same experience received the basic complex (comparison group C2).

In order to evaluate the effectiveness of preventive events, we carried out checkups before and after the prevention course that included an assessment of the adaptation level (calculation of adaptation potential), the adaptation response and the reactivity level (according to L.Kh. Garkavi), the immunoreactivity (identifying concentration of Ig A, G, M immunoglobulins according to G. Mancini et al; IL-10 cytokine's content in blood serum using the enzyme-linked immunosorbent essay; subpopulation of lymphocytes with CD3+, CD4+, CD8+, CD16+, CD19+ antigens using the method of calculating antigen-positive cells; neutrophils' phagocytic activity) and the psychological testing (the MFI-20 scale, the scales developed by C.D. Spielberger and Yu.L. Khanin, the "State of health in extreme conditions" and "Identifying neuropsychic stress" questionnaires developed by T. Nemchin).

To evaluate risk of developing occupational diseases among the river transport personnel, we used developed prediction models. The obtained model for sensorineural hearing loss with the logistical regression model was statistically significant if χ^2 =20,25, p<0,001 (sensibility=71,7%, specificity=81,6%, diagnostic accuracy=76,8%). Model for vibration white finger was also statistically significant if χ^2 =35,34, p<0,001 (sensibility=88,9%, specificity=96,0%, diagnostic accuracy=94,9%).

The obtained results were processed using the PASW Statistics 18 packet, version 18.0.0 (30.07.2009) (SPSS Inc., USA, license owner – FSBI "SibFSCC of the FMBA of Russia"). We used the Kolgomorov-Smirnov and Shapiro-Wilk tests to check the normal distribution hypothesis. The Kruskal-Wallis H-test and the Mann-Whitney U-test was used for evaluating differences between unlinked samples. For intragroup comparison, the Student's test was used, for intergroup comparison – the Wald-Wolfowitz test was used. To check on the distribution's significance, the Pearson's test (χ^2 test) was used. Critical level of significance when checking statistical hypotheses was considered equal to 0,05.

Results and discussion. The comprehensive prevention treatment had a positive effect on adaptation capabilities of river transport personnel: a number of workers with satisfactory adaptation increased many-fold (by 1,5-2,0 times) (table). Workers with small experience had satisfactory adaptation after the initial prevention course (functional stress was registered in 16% of workers before treatment). In the C1 group, functional stress was preserved in 13% of cases. A number of workers with the high reactivity level was increased from 70% to 83% (χ^2 =9,323, df=1, p=0,002) in the M1 group. A number of workers of the C1 group with the high reactivity level was decreased by 3%. Before treatment, stress reaction was revealed in 16% of cases. After treatment, no stress reaction was revealed in the M1 group, but it was registered in 13% of workers in the C1 group.

After the secondary prevention course, the specific weight of workers with the high reactivity level increased in the M2 group from 66% to 82% (χ^2 =8,585, df=1, p=0,004), in the C2 group – from 60% to 77% (χ^2 =8,067, df=1, p=0,005). There was no stress reaction (before treatment it was registered in 14% of cases). After treatment, it was revealed in 10% of workers in the C2 group. We also discovered an increase of the adaptation potential level: before events, satisfactory adaptation was revealed in 10% of cases, after treatment – in 45% (χ^2 =9,024, df=1, p=0,040). Before treatment, 27% of workers (χ^2 =5,444, df=1, p=0,020) had unsatisfactory adaptation, no unsatisfactory adaptation was registered after treatment.

Positive rearrangements in the immunoreactivity took place under the influence of therapeutic events: positive dynamics of immunity indicators, responsible for protection and adaptation mechanisms of the organism, were discovered. In the group of workers with the experience of 10 years and less, an increase of antibody producing activity of immune competent cells and nonspecific resistance was discovered. The immune status did not change in the C1 group. In the group of workers with the experience of more than 10 years (M2 group), increase of nonspecific resistance and significant dynamics of cell-mediated immunity were also registered: a level of CD16+ lymphocytes increased and stimulation of the humoral immunity (increase in the IgM concentration) occurred. We identified significant dynamics in the cell-mediated immunity only (CD16+ content increased) among workers of the C2 group (table).

Table

Indicators	Groups					
	M1			M2		
	B/t	A/t	р	B/t	A/t	р
CD 3+ lymphocytes,	71,71±	72,57±	0,752	68,07±	68,92±	0,252
% (standard: 40-69)	7,74	6,48		4,12	4,66	
CD 4+ lymphocytes,	42,43±	43,71±	0,400	39,64±	41,85±	0,090
% (standard: 23-45)	6,70	5,31		4,10	5,04	
CD 16+ lymphocytes,	20,86±	19,71±	0,735	17,40±	20,08±	0,042
% (standard: 10-20)	5,08	7,20		2,6	3,44	
CD 19+ lymphocytes,	11,86±	$11,00\pm$	0,461	12,57±	10,38±	0,059
% (standard: 9-29)	5,27	2,89		2,95	4,15	
IgA, g/l	2,23±	2,65±	0,018	2,77±	2,90±	0,128
(норма 1,25-2,9)	0,79	1,04		0,88	1,16	
IgG, g/l	10,68±	10,19±	1,000	11,93±	$10,28\pm$	0,499
(standard: 8,4-17,0)	3,08	1,79		3,27	1,26	
IgM, g/l	1,35±	1,70±	0,237	1,22±	1,47±	0,003
(standard: 1,03-2,2)	0,57	0,65		0,72	0,85	
PhAspon, %	43,43±	47,14±	0,249	41,79±	40,54±	0,937
(standard: 40-60)	14,48	19,27		12,09	12,74	
PhAstim, %	47,43±	51,00±	0,050	45,00±	50,00±	0,068
(standard: 40-80)	12,57	14,17		7,11	5,71	

The systematic immunity indicators in the river transport personnel ($M\pm\sigma$)

Note: B/t – before treatment; A/t – after treatment; p – significance of differences level before and after treatment

Analysis of psychological state of workers with the experience of 10 years and less demonstrated that before treatment, significant signs of reduced activity were revealed in 23,1% (13,0±1,01 points) of workers. After treatment, a statistically significant decrease of this indicator to standard values was observed – 8,66±3,2 (Z=-2,012; p=0,048). At the same time, there were no significant signs of reduced activity in this group after preventive events (χ^2 =3,457; df=1; p=0,046). Among workers with the experience of more than 10 years, there were no substantial differences in psychological indicators of M2 and C2 groups before preventive events. Both groups were characterized by a moderate level of asthenic signs and a mean level of situational and personal anxiety. At the same time, there were symptoms of mental instability, among which insomnia and psychophysiological fatigue were greatly pronounced. The neuropsychic stress level corresponded to the first degree. After the preventive events course, positive dynamics of all indicators were noted in the M2 group: a decrease of severity of asthenic and maladaptation signs, an improvement of a general neurotization and neuropsychic stress indicators and a decrease of situational and personal anxiety.

Comparing results in the M2 and C2 groups after preventive events demonstrated a presence of statistically significant differences in a number of indicators. Therefore, the level of asthenia (from $7,29\pm2,60$ to $5,18\pm1,68$ when p=0,004), neurotization (from $5,70\pm6,08$ to $1,81\pm1,60$ when p=0,015) and stress index (from $35,54\pm4,86$ to $33,00\pm2,78$ when p=0,045) in the main group were lower than in the comparison group. Maladaptation signs were also less pronounced.

Risk of developing health disorders from vibration and risk of developing sensorineural hearing loss among workers with the experience of 10 years and less were not revealed before and after the initial prevention treatment. Risk of developing health disorders from vibration among workers with the experience of more than 10 years was revealed in 23% of cases. After the secondary prevention treatment, 3% of workers with a risk of developing vibration white finger were transferred into the healthy group. The C2 group had the same percentage. The risk of developing sensorineural hearing loss among workers with the experience of more than 10 years was revealed in 68% of cases. After the secondary prevention treatment, 2% of workers of the M2 group were transferred into the healthy group (positive dynamics were confirmed by the data from tone audiometry – mean values of hearing in these workers amounted to 10 dB). Risk of occupational hearing loss was preserved in all workers of the C2 group.

In order to prolong profession longevity of river transport personnel, it is more effective to carry out the prevention of occupational diseases when a certain number of processes is still treatable. Implementing prevention events in spa conditions will allow influencing comprehensively on engaged functional systems.

During voyages, river transport personnel with the experience of 10 years and less are prescribed the therapeutic prevention course based on applying physical agents contributing to an increase of adaptation capabilities of the organism, an achievement of positive shifts in systems of nonspecific protection, immune status, peripheral and cerebral vessels that optimize reactivity.

During the same period, the complex is being supplemented by methods supporting an increase of self-regulation, a preventive drug therapy, an effect of physical factors improving blood supply to the brain and the inner ear and stimulating functions of auditory pathways for the second prevention treatment of river transport personnel with the experience of more than 10 years.

Carrying out therapeutic and preventive events for the river transport personnel in spa conditions increases their adaptation and psychological capabilities, causes positive rearrangements in the immunoreactivity, i.e. an activation of both specific and nonspecific links of cell-mediated immunity, as well as a stimulation of immune adaptation responses.

Conclusion.

1. Carrying out comprehensive prevention of vibration white finger and sensorineural hearing loss in river transport personnel allows influencing significantly on the severity of pre-nosological disorders.

2. Increasing adaptation capabilities of engaged functional systems allows reducing risks of developing occupational diseases.

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