Influence of recovery treatment based on the haloaerosoltherapy upon non-specific defense of children with recurrent respiratory diseases

Key words: children, recurrent respiratory diseases, recovery treatment, haloaerosoltherapy.

Respiratory diseases in children remain an actual problem in medicine [9, 16], and recurrent respiratory diseases (RRD) occupy a special place among them [16, 19, 21]. Recurrent episodes of the disease, especially on the background of residual changes following acute respiratory diseases (ARD), may have a protracted duration and further contribute to the formation of chronic diseases of the bronchopulmonary system [1, 3, 7, 20].

Accounting the important role of the immune system, which goes through a formative stage during childhood, special attention should be paid to the evaluation of changes in the indices of non-specific defense, which defines the first line of defense against infectious agents [8, 11, 18]. Studies by different researchers indicate changes in the macrophage branch of the immune system [2, 11, 13] in children with frequent ARD, which can persist even after the subsidence of acute manifestations.

Therefore, children with RRI require long-term control and comprehensive rehabilitation with predominant use of non-medicamental methods to provide adequate immune correction [5, 6, 10, 14]. In this aspect, haloaerosoltherapy (HAT) is of worth attention, since it directly influences the drainage function of the bronchi due to the hyperosmolar effect, is characterized by bactericidal action and indirectly provides correction of immune disorders [4, 15, 17].

Objective was to study the influence of different treatment complexes (TC) based on HAT with increased concentration of rock-salt aerosol upon non-specific defense at children with RRD.

Materials and methods. 74 patients aged 6 to 11 years were examined, all children were beyond acute period. The inclusion criteria were four or more recurrences of ARD during the year, that is, among them: rhinopharyngitis, laryngitis, tracheitis or bronchitis. The control group consisted of 12 practically healthy children of the same age.

The spontaneous and induced phagocytic reserve of neutrophils (PhR) was also evaluated by nitro blue tetrazolium test (NBT-test). The content of lysosomal cationic proteins (LCP) in neutrophils was determined, the percentage of positive cells (LCP%) and the intensity of the test by the cytochemical coefficient (CCC LCP) were taken into account. Simultaneously, the content of the myeloperoxidase enzyme (MPO) with the determination of the percentage of positive cells (MPO%) and the calculation of the cytochemical coefficient (CCC MPO) was studied.

The treatment was conducted within two treatment complexes (TC). TC-1 (standard) included 18 sessions of haloaerosoltherapy with increased intensity of haloaerosol influence [12]. The concentration of rock salt aerosol varied from 40 mg/m³ at the beginning to 35 mg/m³ at the end of the 30 minute session, aerosol particles up to 6 μm in size ranged from 70% to 75%. Such parameters provide direct influence on the mucosa of different levels of the respiratory tract and allow taking into account the peculiarities of the pathogenesis of the pathological process.

The course of treatment included a period of adaptation to the haloaerosol for 2–3 days, with the duration of procedures from 10 to 30 minutes, and the main period, with
the duration of sessions for 30 minutes each. TC–2 provided reduction of the haloaerosoltherapy course to 13 procedures with the simultaneous prescription of singlet oxygen therapy (SOT) in the form of oxygen foam, which was received by MIT–C device produced in Ukraine, within 12 procedures of 200 ml. The statistical processing of the results was carried out using the standard program package «Statistica 6.0 for Windows».

**Results and discussion.** Before treatment in children with RRD, in comparison with the control group of practically healthy children, inhibition of the absorption properties of neutrophils and monocytes was observed. Thus, there was a significant decrease in the PhAN to 44,0±1,22%, compared to 50,3±0,76% in the control (p<0,001), and some decrease in PhNN to 3,24±0,09 at norm 3,54±0,13 (p<0,1), which contributes to the weakening of anti–infective defense.

The decrease of absorption properties of monocytes has been also revealed. Thus, the values of PhAM and PhNM were significantly lowered to 35,3±0,93% versus 42,5±0,95% in the control group (p<0,001), and to 2,72±0,07 at normal level 2,99±0,04 (p<0,01) accordingly, which may affect the antigen presentation process.

Neutrophils also revealed a significant decrease in the spontaneous NBT–test to 23,1±0,76%, compared to 27,1±0,80%, in the control (p<0,001) and induced NBT–test to 29,5±0,77%, with a norm of 35,5±0,92% (p<0,001), indicating a lack of functional reserves of the phagocytic activity of neutrophils, and is confirmed by a decrease in the PhR, which corresponded to 6,41±0,49%, against 8,47±0,65% in healthy children (p<0,02).

Study of intracellular microbial cytotoxic properties of neutrophils revealed a significant decrease in MPO% levels, which was 90,3±0,55% with a norm of 92,3±0,63% (p<0,02), and a CCC of MPO equal to 1,75±0,04 vs. 2,06±0,05% in control (p<0,001), which reflects the inhibition of the ability of intracellular destruction of a alien antigen. Changes in oxygen–independent antimicrobial properties of neutrophils were less significant. Thus, the percentage of LCP was 88,9±0,60%, compared with 90,3±0,45% in the control group (p<0,1), and the value of CCC LCP was 1,46±0,03, compared with 1,55±0,04 within normal ranges (p<0,1).

Thus, in children with RRD even beyond of the acute period there was a significant reduction in anti–infective defense due to inhibition of the absorption properties of neutrophils and monocytes and suppression of intracellular defense.

<table>
<thead>
<tr>
<th>Indices, units</th>
<th>Control group (n=12)</th>
<th>TC-1 (n=35) before treatment</th>
<th>after treatment</th>
<th>TC-2 (n=39) before treatment</th>
<th>after treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhAN, %</td>
<td>50,3±0,76</td>
<td>44,1±1,35**</td>
<td>49,3±1,19 &lt;0,01</td>
<td>44,0±1,08**</td>
<td>48,6±1,26* &lt;0,01</td>
</tr>
<tr>
<td>PhNN</td>
<td>3,54±0,13</td>
<td>3,25±0,11*</td>
<td>3,65±0,10 &lt;0,01</td>
<td>3,24±0,08*</td>
<td>3,57±0,09 &lt;0,01</td>
</tr>
<tr>
<td>spontaneous NBT-test, %</td>
<td>27,1±0,80</td>
<td>23,1±0,94**</td>
<td>26,6±0,76 &lt;0,01</td>
<td>22,9±0,59**</td>
<td>26,2±0,77 &lt;0,001</td>
</tr>
<tr>
<td>induced NBT-test, %</td>
<td>35,5±0,92</td>
<td>29,4±0,89**</td>
<td>33,6±1,03 &lt;0,01</td>
<td>29,6±0,66**</td>
<td>33,3±0,64* &lt;0,001</td>
</tr>
<tr>
<td>PhR, %</td>
<td>8,47±0,65</td>
<td>6,23±0,57**</td>
<td>7,06±0,53&lt; 0,01</td>
<td>6,59±0,41**</td>
<td>7,00±0,58*</td>
</tr>
<tr>
<td>MPO, %</td>
<td>92,3±0,63</td>
<td>90,8±0,55*</td>
<td>93,7±0,39 &lt;0,001</td>
<td>89,6±0,54*</td>
<td>92,3±0,58 &lt;0,01</td>
</tr>
<tr>
<td>CCC MPO</td>
<td>2,06±0,05</td>
<td>1,76±0,05**</td>
<td>2,05±0,05 &lt;0,001</td>
<td>1,74±0,03**</td>
<td>1,98±0,04 &lt;0,001</td>
</tr>
<tr>
<td>LCP, %</td>
<td>90,3±0,45</td>
<td>89,3±0,60*</td>
<td>91,5±0,43 &lt;0,01</td>
<td>88,5±0,61*</td>
<td>91,1±0,36 &lt;0,001</td>
</tr>
<tr>
<td>CCC LCP</td>
<td>1,55±0,04</td>
<td>1,47±0,03*</td>
<td>1,57±0,02 &lt;0,01</td>
<td>1,45±0,02</td>
<td>1,59±0,02 &lt;0,001</td>
</tr>
<tr>
<td>PhAM, %</td>
<td>42,5±0,96</td>
<td>36,6±1,06**</td>
<td>42,9±1,39 &lt;0,001</td>
<td>33,9±0,81**</td>
<td>40,9±0,96* &lt;0,001</td>
</tr>
<tr>
<td>PhNM</td>
<td>2,99±0,04</td>
<td>2,85±0,07*</td>
<td>3,07±0,09 &lt;0,1</td>
<td>2,60±0,07**</td>
<td>3,04±0,12 &lt;0,01</td>
</tr>
</tbody>
</table>

Notes:** – statistically valuable difference (p<0,05) between results in comparison with norm (control group);
* – tendency to statistically valuable difference between results in comparison with norm;
p – statistical accuracy of difference between results before and after treatment.
antimicrobial activity, which may be a pathogenetic ground for the progression of infectious inflammatory process and requires appropriate immunomodulation.

As a result of the recovery treatment carried out, positive dynamic of the nonspecific defense indices under study was observed on the background of the absence of significant differences between the background of the treatment complexes (see table).

Thus, under the influence of TC-1 (standard HAT course) there was a significant increase and normalization of the PhAN and PhNN values; the PhNN increased slightly (p<0,1), but normalized.

The research also showed that TC-2 results in a significant improvement in the functional status of neutrophils, according to the spontaneous and induced NBT test (p<0,01), with a slight increase in the PhR level up to 7,06±0,53%. However, after treatment, the values of the induced NBT—test and PhR haven’t reached the normal values. Improvement of the function of intracellular bactericidal activity of the alien antigen in neutrophils was manifested in the significant increase in the MPO% index and the values of the CCC MPO that were normalized. Strengthening of the phagocytic function of neutrophils after the standard HAT course was confirmed also by a significant increase and normalization of LCP% and CCC LCP indices.

The use of the reduced regime of HAT (TC-2) also contributed to the positive dynamics of the indices under study. The levels of PhAN and PhNN have significantly increased and normalized. Monocytes also significantly increased and PhNM (p<0,001) and PhNN (p<0,01) normalized, which contributes to the development of an adequate immune response to the antigenic stimulus. The value of the spontaneous and induced NBT—test increased significantly, indicating an improvement in their metabolic characteristics, while the level of the induced NBT—test did not reach the norm (p<0,1), and the level of PhR increased significantly and did not reach the value of healthy children (p<0,1). At the same time, there was a significant improvement in the bactericidal properties of neutrophils according to the MPO%, LCP% and the corresponding cytochemical coefficients, the values of which have been normalized.

That is, the duration of the HAT course may be shortened, but only with the simultaneous prescription of an additional therapeutic factor, in particular singlet—oxygen therapy.

Conclusions. In children with RRD out of acute period, a decrease in the absorption capacity of neutrophils and monocytes was observed, which was accompanied by a significant decrease in the functional reserves of neutrophils and a predominant inhibition of their oxygen—dependent mechanisms of intracellular bactericidal activity. These changes can disrupt an adequate immune response and indicate a reduction in anti—infective defense, which can contribute to the protracted course of the pathological process and requires the necessity of recovery treatment and immunocorrection.

The use of the proposed TC based on HAT in children with RRI resulted in the improvement of the studied indices with the normalization of most of them, which contributes to the improvement of antigen presentation and anti—infection defense in general and allows preventing the progression of the pathological process and the development of chronic pathology of bronchopulmonary system. The absence of a significant difference in the effectiveness of the proposed TC indicates the possibility of reducing the duration of the course of HAT, subject to the additional prescription of another therapeutic factor, in particular, SOT.

Monitoring of cellular immunity, as well as monitoring of the long—term results of various courses of recovery treatment, including halotherapy, is also relevant for children with RRD out of acute period.

References


