Abstract

In Romania, bronchial asthma represents a major public health problem.

SCOPE: The study discusses the effects of bacterial plaque control upon the quality of respiration in a group of asthmatic children previously subjected to professional dental scaling and brushing, comparatively with a similar group, whose habits of oral hygiene had not been influenced. In both groups, the indices of bacterial plaque and gingival bleeding were calculated, respiratory functional samples were taken, the number of eosinophylls, the concentration of seric IgE and salivary sIgA were analyzed, and bacterial concentration and morphology of the dental plaque were determined.

Statistically, the quality of respiration has been significantly improved in the children whose dental plaque had been controlled. Correlations have been evidenced among asthma symptomatology, indices of oral health, immunological markers and the bacterial profile of the dental plaque.

Keywords: bronchic asthma, oral hygiene.

INTRODUCTION

Bronchic asthma is a frequently occurring disease of childhood, the physiopathology of which involves inflammation of the aerial ducts, intermittent obstruction of the aerial flow and bronchic hyper-responsivity [1].

The microorganisms especially present in periodontal pathologies contribute to the initiation or exacerbation of chronic respiratory diseases [2,3]. Bronchic asthma appears in 7% of the children of România [4]. Antiasthmatic medication has adverse effects, manifested both systemically and at the level of the oral cavity, causing reduction of salivary secretion and of local immunity, thus favorizing the development of pathogenic bacteria [5]. Even if, according to the GINA 2010 recommendations, [6] management of bronchic asthma is approached in a multidisciplinary manner, 40% of the subjects remain symptomatic. To avoid, as much as this is possible, the occurrence of an asthmatic crisis, no trigger agents should be employed, antiasthmatic medication remaining the main controlling mechanism of the disease [7].

The authors put forward the hypothesis that the dental bacterial plaque might immunologically affect the respiratory ducts, while oral bacteria may act as triggers in provoking asthmatic crises, thus aggravating the suffering.

The authors attempted at completing the investigation of Utomo H. et al. [8], who demonstrated the effects of oral infections elimination and of dental plaque control, through scaling and radicular planning, upon the respiratory quality of children affected with asthma. In such cases, evaluation of respiratory quality was performed one week after hygienization of the oral cavity. The present study, performed over a prolonged time period, analyzes a higher number of markers.

MATERIALS AND METHOD

The investigation was performed between May – June 2011. On the basis of the observation sheets, 62 children with bronchic asthma diagnosed through clinical evaluation and spirometry, according to GINA 2010 recommendations [6], have been selected for the study. The functional respiratory samples were taken by the same pneumologist (V.O), between 9-10 a.m. The values of the maximum expiratory volume in the first second (FEV₁) – pre- and post-bronchodilatorily [6] – were recorded, selected for the study being 25 children, affected with moderate...
persistent asthma, with ages between 5 and 14 years, whose post-bronchodilatatory FEV₁ increased with at least 12% (or 200 ml), comparatively with the pre-bronchodilatatory FEV₁, according to the reversibility criteria of FEV₁, [7,9], with no acute exacerbations requiring the administration of antibiotics during the investigation and a month prior to its initiation. None of them showed comorbidities associated to asthma. The subjects with severe marginal periodontites, severe dental anomalies or those wearing orthodontic devices have been excluded. Over the whole period of the investigation, all children continued the treatment recommended by the pneumologist.

Invitations have been sent to their families to participate to a stomatologic control and their informed consent was obtained. The following parameters were registered for all children: age, sex, height, weight, asthma history, extent of severity of the disease, antiasthmatic medication administered and the duration of its administration, possible acute exacerbations prior to the examination. The children were randomly divided into two groups: A (experimental, n=13) and B (control, n=12), according to their age, sex, severity of asthma and results of the initial paraclinical examinations. All children received pocket-books, that should be daily filled in, containing simple questionnaires, providing information on the realization of dental hygiene, quality of breathing, cough, wheezing, weakening during the night and daily activity. The allergologic history, the factors provoking asthmatic crises, the allergologic tests performed, the possible presence, in the family, of antecedents of allergic diseases, were all registered in patients’ files.

Venous blood was collected from all children, for the analysis of the number of eosinophylls and of the concentration of seric IgE (by the immunoenzymatic method), both in the beginning and end of the investigation. Also, stimulated saliva, obtained after chewing for 5 min of some sterile paraffin tablets (GC Saliva Check®), was collected, for determining the concentration of secretory IgA (by ELISA method).

All subjects were examined – as to the status of the oral cavity – in the stomatological office, by the same examiner (M.O.), subjected to weekly controls up to the end of the investigation being only the children from the experimental group, while those from the control one were examined only in the beginning and end of the study.

In the beginning and end of the study, the index of bacterial plaque (IP) was determined for all children, by means of Silness and Loe index and of the index of gingival bleeding [10-12]. From each of the subjects, 2 samples of supragingival dental plaque were collected, with sterile excavators, from the oral and vestibular surfaces of the first molars. All plaque samples taken over from the same patient were put in a single sterile tube containing 1 ml solution of physiological serum. The samples were centrifuged for 10 min. Out of the resulting supernatant, culture media (gelose blood) were impregnated and incubated at 37°C for 24 hr. Bacterial growth was evaluated by spectrophotometric measurements of the optical density of the suspended cells, for the determination of microbial mass, and by numeering of the bacterial units forming colonies (cfu). From the numerically-representative bacterial colonies, for each patient, coloured gramm smears, microscopically identified (13), were produced, their bacterial morphology being established. The modifications observed in the health status of the oral cavity and in the profile of the oral bacterial flora were evidenced and correlated with the severity of asthma, FEV₁ reversibility, quality of respiration, number of blood eosinophylls and concentration of seric IgE and salivary sIgA.

The oral hygiene of the subjects from the experimental group was controlled through ultrasonic scaling and professional brushing. They were instructed as to the correct technique of dental brushing, the recommendation made being to rinse their mouth with a mouthwash solution at least twice a day, as well as mouth rinsing after administration of the inhalating medication. Further on, the children were consulted each week for the visual evaluation of the bacterial plaque and control of oral cavity hygiene. The subjects from the control group were evaluated as to the hygiene of their oral cavity in the beginning and end of the study, yet without influencing in any way their oral hygiene habits. For all children included in the study, excision
of altered dentin and provisional obturation of simple caries were performed.

In the end of the study, the children from both groups benefited from professional brushing and scaling, being also instructed on the manner of maintaining oral cavity hygiene.

All data obtained were registered in IBM® SPSS Statistics Desktop V20.0., for Windows and Excel Office. For subsequent statistical processing, the t, square chi, exact Fisher, Kendall, Pearson and Mann-Whitney tests were employed. A p < 0.05 value and a confidence interval of 95% were considered statistically significant. The correlation between the modification of the bacterial profile in the children with controlled oral hygiene and the improvement of the variables measuring respiratory quality was also stated.

RESULTS

Analysis of the observation sheets evidenced no considerable differences among the subjects of the investigated groups. The history of the asthmatic affection was similar for all children under analysis (i.e. > 12 months), as well as the results of the respiratory functional samples and of the blood marker values, registered during the first examination. Statistically significant differences appeared, nevertheless, at the final exam, both in the concentration of salivary sIgA and seric IgE values, and in the number of eosinophylls in children suffering from allergic asthma, comparatively with those with idiopathic asthma. The children coming from families in which at least one parent had asthma or allergic diseases showed a 6.8 times higher frequency of asthma, comparatively with those with no allergic history in the family (p<0.001).

In the experimental group, 6 children had allergic asthma (AA) and 7 – idiopathic asthma (AI). 6 boys and 7 girls of the group, with a mean age of 9.5±3.1 years for the AA ones, respectively 9.2±1.2 years for the AI ones, recorded a mean value of the index of bodily mass (IMC) of 16.4±2.5 kg/m² (AA), respectively 15.8±2.3 kg/m² (AI). 6 children registered positive cutaneous tests to different allergens: dust (3), various aliments (2), animal hair (1). All children included in the study had triggers provoking asthmatic crises, most frequently involved being the exposure to specific allergens, low temperatures and physical effort.

The indices of bacterial plaque and gingival bleeding demonstrated reduced values in the children of the experimental group each examination week. The values of the index of bacterial plaque were of 2.89±0.7 on first examination, decreasing up to 2.1±1.03 on the last one (p<0.001). The index of gingival bleeding showed values of 1.71±3.92 on first examination, decreasing up to 1.45±2.4 on the last one (p=0.03). In the children of the control group, no statistically significant modifications of the indices of bacterial plaque and gingival bleeding were observed between the initial and the final examination (p>0.05). In this group, only 2 children showed lower values of these indices, yet without inducing significant modifications of the final mean value in the control group (table 1).

The number of blood eosinophylls showed significant reductions, from 466.4±100.3/mm³ up to 219.6±94.33/mm³, between the first and the last evaluation (p<0.0001), in the children from the experimental group, comparatively with those of the control, where the decrease in the number of eosinophylls in peripherical venous blood showed no statistically significant values (p>0.05) (table 1).

The concentration of seric IgE decreased with statistically significant values, from 546.3±77.2 ME/ml up to 395.2±78.2 ME/ml (p<0.001), in the children of the experimental group.

Estimation of salivary sIgA concentration in the children under study recorded statistically significant variations between the first (158.8±13.9 mg/l) and the last determination (265.7±35.6 mg/l) (p<0.001) for the subjects of the experimental group, comparatively with those of the control, both on the first (161.6±23.7 mg/l) and last determination (169.1±45.7 mg/l) (table 1).

On first examination, analysis of bacterial flora evidenced no differences between the two
EFFECTS OF ORAL HYGIENE UPON THE QUALITY OF BREATHING IN CHILDREN SUFFERING FROM BRONCHIAL ASTHMA

Table 1. Parameters of breathing quality

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental group (control of bacterial plaque)</th>
<th>Control group (no control of dental plaque)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First consultation (week 1)</td>
<td>First consultation (week 1)</td>
</tr>
<tr>
<td></td>
<td>Second consultation (week 2)</td>
<td>Last consultation (week 4)</td>
</tr>
<tr>
<td></td>
<td>Third consultation (week 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eosinophills/mm³ (n)</td>
<td>466.4±100.5</td>
<td>461.2±158.5</td>
</tr>
<tr>
<td>Séric IgE (ME/ml)</td>
<td>546.3±77.2</td>
<td>496.5±76.3</td>
</tr>
<tr>
<td>Salivary slgA (mg/l)</td>
<td>158.8±13.9</td>
<td>161.6±23.7</td>
</tr>
<tr>
<td>Basal FEV1 (%)</td>
<td>72.6%±10.4</td>
<td>71.2%±16.9</td>
</tr>
<tr>
<td>Post-bronchodilatory FEV1 (%)</td>
<td>85.2%±16.2</td>
<td>85.87%±18.5</td>
</tr>
<tr>
<td>?FEV</td>
<td>12.6±11.8</td>
<td>14.67±11.3</td>
</tr>
<tr>
<td>IP</td>
<td>2.89±0.7</td>
<td>2.86±1.15</td>
</tr>
<tr>
<td>LG</td>
<td>1.71±3.92</td>
<td>1.68±3.67</td>
</tr>
</tbody>
</table>

ΔFEV = Percent difference between post-bronchodilatory and basal FEV1

Table 2. Characteristics of bacterial plaque in asthmatic children

<table>
<thead>
<tr>
<th>Bacterial profile</th>
<th>Experimental group (n=13)</th>
<th>Control group (n=12)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First exam</td>
<td>Final consultation</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nr. Bacteria (×10⁷ ufc/ml)</td>
<td>5.2±2.5</td>
<td>3.1±2.2</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Gramm positive cocci</td>
<td>13</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Gramm positive bacilli</td>
<td>4</td>
<td>3</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Gramm negative cocci</td>
<td>10</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Gramm negative bacilli</td>
<td>13</td>
<td>3</td>
<td>P&lt;0.01</td>
</tr>
</tbody>
</table>

groups of children. However, significant differences could be observed in the bacterial profile of the children from the experimental group between the first and last examination, as well as between the children from the experimental group, comparatively with those of the reference, as a result of the control of the bacterial plaque applied to the first ones. The modifications referred to a statistically significant reduction in the average number of colony-forming bacteria (cfu) – with 40.7% (1.7±1.4) × 10⁷ cfu/ml (p<0.001), and to the changed composition of the flora, on the last evaluation, comparatively with the first one (table 2), in the children of the experimental group. Application of the control of bacterial plaque evidenced significant reductions of the colonizations with gramm negative bacilli in 56% of the subjects (p<0.001). In the control group, where no control of the bacterial plaque was made, the initial and final bacterial cultures showed similar results (table 2).

If considering the characteristics of the dental bacterial plaque, recorded on first examination, in the experimental group, mainly present – in equal ratios of 38.9% – were the gramm positive cocci and the gramm negative bacilli, followed by the gramm negative cocci and the gramm positive bacteria. In the end of the study, the bacterial profile was represented by 72.2% gramm positive cocci and by 16.7% gramm positive bacilli.
negative bacilli. In 11% of cases, no bacterial cultures were developed. In the control group, on first examination, the bacterial profile was dominated by gramm positive cocci (50%), followed by gramm negative bacilli (27.8%), gramm negative cocci (16.7%) and gramm positive bacilli (5.6%). In the end of the study, the gramm positive cocci represented 50% of all bacterial populations, the gramm negative cocci and bacilli – 22.2% each, and the gramm positive bacilli – 5.6%.

The last examination of the experimental group evidenced a significant improvement of the clinical manifestations of the disease, and a lower FEV1 reversibility – with a mean value of 10.02±3.5% (p<0.001) of the basic value.

As to the statistical correlation between the realization of bacterial plaque control and respiratory quality, positive correlations were obtained between the control of the dental plaque and microbial colonization (r=0.592; p<0.001). Also, reduction of microbial colonization was negatively correlated with the gradual decrease of asthma severity (r=-0.321; p=0.004), of FEV1 reversibility (r=-0.356; p=0.028), of the number of eosinophylls (r=-0.213; p=0.179) and of seric concentration of IgE (r=-0.226; p=0.183), and also with the increased concentration of salivary sIgA (r=-0.375; p=0.016).

Control of the bacterial dental plaque was positively correlated with the number of gramm negative bacilli present in it (r=0.586; p=0.003). In their turn, they evidenced negative correlations with the decrease of the severity extent of asthma (r=-0.501; p=0.01), of asthma reversibility (r=-0.573; p=0.002), of the number of blood eosinophylls (r=-0.444; p=0.025) and of the concentration of seric IgE (r=-0.542; p=0.023), respectively. Also, control of the bacterial plaque was positively correlated with the increase of salivary sIgA (r=0.509; p=0.237) which, in its turn, was negatively correlated with the index of gingival bleeding and with that of bacterial plaque (r=-0.465; p=0.116; respectively r=-0.441; p=0.432). During the study, the children from the experimental group demonstrated a higher frequency of brushing – of up to 3 times a day (p<0.001). Neither of the children from the control group reported modifications of one’s habits of oral hygiene.

**DISCUSSION**

The relation between the suffering of the marginal periodontium and asthma has been intensively studied in literature [2,3]. The role played by bacteria in the development and progress of allergic inflammation evidences some important aspects on the relation between the diseases of the oral cavity and the occurrence or exacerbation of bronchic asthma. Once inhaled, the bacteria and bacterial endotoxines from the dental plaque behave as triggers of the inflammatory response, along with the increase of seric concentration of the mediators of acute inflammation [14,15]. The progress recorded in the identification of the bacterial species acting as periodontal pathogenic agents, as well as the identification of the systemic mechanisms of action of the bacterial products (endotoxines, inflammatory cytokines) opened new routes for a realistic analysis of the systemic importance of oral infections and of the periodontal diseases. [16,17] From this perspective, control of the dental bacterial plaque may be especially important against the sensitivity to microbial agents, in children suffering from asthma.

The most important periodontal pathogenic agent, the gramm negative bacillus, identified in a 50% ratio in the supragingival plaque of the children here under study, was *Porphyromonas gingivalis*, known as playing an essential role in eosinophilic inflammation, and in the action of endotoxines in allergies and asthma. [14]

Analysis of the correlation between the bacterial profile and the quality of respiration showed that the total number of bacteria was significantly reduced after the application of control upon oral hygiene, yet without any significant correlation with the extent of severity of asthma and with the respiratory function (r<0.4; p<0.5). The number of bacterial colonization was not correlated with the number of blood eosinophylls. A significant association has been identified between the variables which analyze respiratory breathing and the reduced ratio of gramm negative bacilli (r>0.4; p<0.05). The advantages brought about by the control of dental bacterial plaque upon the quality of respiration in children suffering from asthma have been underlined. Clinical symptomatology, the lung function, FEV1
reversibility and the immunological markers were considerably improved when control of oral hygiene was applied in the experimental group. Similar results were obtained by other authors in their analyses on the composition of dental bacterial plaque in children with bronchial asthma [15,16]. The increase of sIgA concentration in such children confirms a reduced activity of the non-specific protection factors and of local immunity in the pathology of the child affected with bronchial asthma. The low concentration of sIgA is viewed as a compensating reaction, which nevertheless denotes the immaturity of the protection factors in cases of chronic allergic inflammation. The extent of eosinophilia in asthmatic children was proportional with the severity of the pathology, measured by the clinical gradient of the lung function, most of the children evidencing high concentrations of blood eosinophylls, which actually suggests that atopic asthma is associated with inflammation. [7]

In the end of the study, the children of the experimental group showed improved indices of bacterial plaque and of gingival bleeding, comparatively with the values of the initial examination and with those of the children from the control group.

Most of the children evidenced a negative correlation between the control of dental bacterial plaque and asthma. Clinical symptomatology and the quality of respiration was improved with the reduction of dental plaque and modification of the microbial profile, which demonstrates the role of oral infections in the etiology of allergic reactions in cases of asthma. The results here discussed agree with those of Friedrich et al. on the correlation between periodontitis and allergic respiratory diseases. [17]

Analysis of the cfu number from the bacterial plaque, as well as of bacterial morphology, evidenced statistically significant reductions in the number of bacteria, mainly of the gramm negative bacilli (p<0.01), in the children subjected to a periodontal treatment, comparatively with those benefiting of no medical intervention. The gramm negative bacilli constituted the main bacterial group, appearing as significantly reduced after the application of the treatment for bacterial plaque removal in the children of the experimental group, being positively correlated with their improved respiratory quality. When inhaled, the lipopolysaccharides (LPZ) released by the gramm negative bacilli were associated with bronchoconstriction [18], the allergic subjects being more sensible to the bronchoconstricting properties of LPZ than those with no atopia. At the same time, inhalation of LPZ stimulates the response of T helper lymphocytes and the expression of interleukine I15 by mastocites, both through their activation and increased number of eosinophylls, which exacerbate the clinical signs of asthma. [19]

In its turn, antiasthmatic medication plays an important role upon the oral cavity flora [20,21], favourizing mainly the development of pathogenic periodontal species and adhesion of the respiratory pathogens to the dental plaque, so that maintenance of a strict hygiene of the oral cavity, for preventing the occurrence and exacerbation of bronchial asthma and of the periodontal diseases, should become a must.

Comparatively with the study developed by Utomo et al., on the respiratory quality of children with asthma, after scaling and radicular planning, the present investigation provides new data on the morphology of bacterial plaque in children with asthma, subjected to controlled dental hygiene, vs. a group of children whose hygiene habits had not been influenced. Also, new information were brought on the value of the seric and salivary immunological markers, which are frequently altered in children affected with bronchial asthma. A controlled oral hygiene along the whole development of the study induced improvements of the seric and/or salivary concentrations of the immunological markers here investigated, as well a better respiratory quality of the children with asthma, included in the experimental group.

**CONCLUSIONS**

The severity of asthma is directly correlated with the intensity of the obstructive syndrome, appreciated by the value of FEV1. The respiratory quality of the children included in the study was correlated with the concentration of seric IgE, number of eosinophylls, concentration of salivary sIgA and also concentration and composition of oral bacterial flora.
Children suffering from asthma should pay special attention to their oral hygiene. A strict control of the dental plaque should be part of the management of bronchial asthma in children. Especially important is the cooperation among the different medical disciplines, for the implementation of a corresponding oral hygiene, for preventing the diseases of the oral cavity and also for preserving the respiratory quality of asthmatic children.

Nevertheless, no sufficient proofs to support a clear-cut causal relation between the infection of the oral cavity and bronchial asthma have been stated. Further studies are therefore required, performed on larger groups of subjects and over more extended time periods, for a most precise determination of the effects of oral hygiene upon the respiratory quality of asthmatic children.

References

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