Comparative assessment of aluminum and lead concentrations in serum and tissue biopiates in patients with laryngeal papilloma or cancer


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Abstract. Comparative assessment of aluminum and lead concentrations in serum and tissue biopiates in patients with laryngeal papilloma or cancer. A comparative assessment of toxic element concentrations in serum and tissue biopiates in patients with laryngeal papilloma or cancer was performed. Examinations were conducted in 60 patients (40 men and 20 women) aged 20-88 years (average 59 ± 05). Patients were divided into 3 groups; 20 patients with laryngeal papilloma were in group I, 20 with laryngeal cancer were in group II, and 20 with deviated nasal septums were included as a control group (III).

Diagnosis of laryngeal papilloma (removed by direct microlaryngoscopy - Kleinsasser method) and laryngeal cancer (removed by the Rethi method) was histopathologically confirmed in patients from groups I and II, respectively. Patients in the control group received functional surgery to repair deviated nasal septums. Serum and tissue samples were obtained from all patients before surgery. Aluminum and lead concentrations were analysed by inductively coupled plasma atomic emission spectrometry (ICP - AES) using a Spectroflame M spectrometer.

The considerable rise of aluminum and lead concentration in tissue biopiates and aluminum in serum in groups I and II in comparison to the control group suggests that these elements may play a significant part in the aetiology and development of precancerous lesions and laryngeal cancers. Measuring toxic chemical element concentrations in tissue biopiates can be useful in the diagnosis and estimation of development of precancerous lesions of the larynx as well as laryngeal cancer. Toxic elements concentration may play a significant role in carcinogenesis and may determine trends in cancer aetiology.

Introduction

Numerous microelements and metals exhibit a concentration dependent intensification or retardation of the growth of spontaneous or chemically induced tumours.1-4

Trace element deficiency, as well as excess trace elements, can lead to a deterioration of metabolic processes in the human body. Therefore, many diseases may be caused by both an imbalance in the proportion of chemical elements and by the presence of toxic elements such as mercury, lead, cadmium, and aluminum.5,6

Exposure to environmental metals may be increased in large municipal areas and industrial circles.7

The genotoxic, mutagenic influence of environmental chemical and physical factors on development of precancerous lesions and malicious tumours in humans has been the subject of biochemical studies over the past 20 years. The concentration of vestigial elements in biological samples obtained from patients with precancerous lesions of the larynx was investigated in previous studies.8,9 The aim of the present study was to compare the concentrations of toxic elements in serum and tissue biopiates from patients with laryngeal papilloma and cancer.

Material and methods

Sixty patients (40 men and 20 women) aged 20-88 years (mean 59 ± 0.5) seen at the Department of Laryngology, Municipal Hospital in Lublin were divided into 3 groups of 20 patients each based on diagnosis. Group I included 14 men and 6 women aged 43-73 years (mean 59 ± 0.5) with adult laryngeal papilloma. Group II included 16 men and 4 women aged 42-88 years (mean 66 ± 0.5) with laryngeal cancer. Group III (control group) included 10 men and 10 women aged 20-41 years (mean 33 ± 0.5) with deviated nasal septums.

Diagnosis of laryngeal papilloma (removed by direct microlaryngoscopy - Kleinsasser method) and laryngeal cancer (removed by the Rethi method) was histopathologically confirmed in patients from groups I and II, respectively. Patients in the
control group received plastic surgery to repair deviated nasal septums.

Before surgery serum samples and during surgery biopsies (altered tissues in groups I and II, or a segment of cartilage from the nasal septum in group III) were obtained from all patients.

Trace elements were assayed at the Institution of Analytic Chemistry, Chemistry Institute of Silesian University, in Katowice.

Aluminum (Al) and lead (Pb) concentrations were analysed by inductively coupled plasma atomic emission spectrometry (ICP-AES) using a Spectroflame M spectrometer (Spectro Analytical Instruments, Germany) under the following conditions: 1.1 kW power, 27.12 MHz frequency, quartz torch, 14.0 l/min external gas, 0.5 l/min indirect gas, 1.0 l/min bearing gas, Meinhard type pneumatic nebulizer, Scott type mist chamber, 1.0 ml/min waste of sample, holographic 2400 outline/mm diffractive mesh, 0.55 nm/mm opposite dispersal in first line, and a 165-460 nm monochromator range.

Results were subjected to statistical analysis with the non-parametric Mann-Whitney test with a level of significance considered to be $p < 0.05$.

**Results**

The mean and extreme values and standard deviation of aluminum for each group are presented in Table 1. The mean value of the serum concentrations of aluminum were 0.79 µg/ml in group I with adult-onset laryngeal papilloma, 1.17 µg/ml in group II with laryngeal cancer, and in 0.51 µg/ml group III. The mean concentration of aluminum in tissue bioptates was 39.99 µg/g in group I, 50.13 µg/g in group II, and 1.58 µg/g in group III. Notable differences in the mean serum aluminum concentrations between groups II and III were found. Mean aluminum concentrations in tissue bioptates were significantly different between groups I and III, and differences between groups II and III were statistically significant ($p < 0.05$) as shown in Table 1.

Mean and extreme values and standard deviations of lead in the 3 groups are presented in Table 2. In group I with adult-onset laryngeal papilloma the mean value of lead was 0.14 µg/ml, and was 0.21 µg/ml in group II with laryngeal cancer, and 0.24 µg/ml in group III. The mean concentration of lead in tissue bioptates was 4.22 µg/g in group I, 9.26 µg/g in group II, and 0.99 µg/g in group III. Notable differences in mean lead concentration in tissue bioptates were found between groups I and III, and differences between groups II and III were statistically significant ($p < 0.05$) as shown in Table 2.

**Discussion**

In a complicated evolutionary process, living organisms developed special adaptive mechanisms in their metabolic processes to cope with the numerous microelements in their environment. The undisturbed circulation of microelements in nature is indispensable for the correct functioning of organisms and to maintain their homeostasis. Based on a survey of the literature aluminum, cadmium, and lead are toxic to humans. The toxicity of aluminum is not fully confirmed. However, current medical and scientific publications unambiguously show that increased aluminum in the tissues of organisms is unfavourable for health. Aluminum readily accumulates in the brain, and many scholars feel it may contribute to the development of Alzheimer’s disease.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Concentration of Al in tissue bioptates (µg/g)</th>
<th>Concentration of Al in serum (µg/ml)</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
<td>□</td>
</tr>
<tr>
<td>I laryngeal papilloma</td>
<td>6.92</td>
<td>63.28</td>
<td>39.99</td>
</tr>
<tr>
<td>II laryngeal cancer</td>
<td>29.45</td>
<td>87.77</td>
<td>50.13</td>
</tr>
<tr>
<td>III control</td>
<td>0.30</td>
<td>5.25</td>
<td>1.58</td>
</tr>
</tbody>
</table>
The present study showed that mean aluminum concentrations in serum were 58.4% higher in group I and 129.4% higher in group II than in the group III control. In tissue bioptates, aluminum was 2431.0% higher in group I, and 3072.8% higher in group II in comparison to the control group. Lead concentrations in serum were 41.7% higher in group I, and 12.5% higher in group II compared to the control group. However, in tissue bioptates the increase of concentrations in group I and II was observed in comparison to group III (suitably 326.3% and 835.4%).

The carcinogenicity of lead is still controversial, although lead is well-known as having toxic properties. Some animal experiments suggest that lead may cause kidney cancer. Large concentrations of lead have been found in the water and in the biosphere where toxic elements have been found in the kidney cancer. Large concentrations suggest that lead may cause development of precancerous lesions and laryngeal cancers.

2. Measuring aluminum and lead concentrations in tissue bioptates may have potential use in the diagnosis and prognosis of precancerous lesions in the larynx, as well as for laryngeal cancer. The hypothesis that toxic elements play a significant role in carcinogenesis could determine trends in further studies of cancer aetiology.

Conclusions

1. The considerable rise of aluminum and lead concentrations in tissue bioptates and of aluminum in the serum of patients with laryngeal papillomas or cancers in comparison to a control group suggests that these elements may contribute to the aetiology and development of precancerous lesions and laryngeal cancers.

References


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