Possible interaction between carious lesions, chronic marginal periodontitis, periapical pathology and salivary iodine level –preliminary results

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Abstract

Since the beginning of administration of iodine to prevent iodine deficiency, children have less dental cavities; iodine seems to increase the resistance to dental caries, retarding the process and reducing its incidence (in Romania the law regarding universal salt iodization was implemented in January 2003). Given its antioxidants properties, iodide may act as an antimicrobial agent in saliva. In our studied groups (group I, II, III) we found a statistically significant difference between the smokers and non-smokers on each of the above mentioned group. Our results confirm previous studies, showed that smoking had an increasing effect on the concentration of salivary thyocianate and a decreasing effect on the content of iodide in saliva.

Key words: periodontal disease, periapical pathology, carious lesions, salivary iodine, thiocyanate, smoking

1. Introduction

Dental caries continue to be the most prevalent chronic disease to affect human population [1]. On the other hand, iodine deficiency disorders (IDD) is arguably the world’s most common endocrine disease [2]. Interestingly, since the beginning of administration of iodine to prevent goiter induced by iodine deficiency, children have less dental caries, iodine seems to increase the resistance to dental caries, retarding the process and reducing its incidence (3). The thyroid gland is unique among the endocrine glands for its dependence on an essential micronutrient (iodine) for normal thyroid hormone production. In Romania, the law regarding Universal Salt Iodization was implemented in January 2003, as the main strategy for eliminating iodine deficiency.

The natrium iodide symporter (NIS) (the iodide pump) is the plasma membrane glycoprotein that mediates active iodide transport in the thyroid and other tissues, including salivary glands [4]. Human NIS is a 643 amino acid protein and contains 643 transmembrane domains. The molecular characterization of natrium iodide symporter (NIS) began in 1996, when Nancy Carrasco’s group isolated the cDNA encoding rat NIS [5]. Although there are similarities between the salivary and thyroid iodine concentrating mechanism (both mechanisms are inhibited by some anions like thiocyanate and perchlorate via competitive inhibition), there are also important differences. The physiological role of iodide secretion in the saliva is a matter of debate [4]. Given to its antioxidant properties, iodide may act as an...
Antimicrobial agent in saliva. A bactericidal/bacteriostatic effect of iodide is consistent with the presence of an H$_2$O$_2$/peroxidase system in the salivary glands [4].

Cigarette smoking is a major source of thiocyanate in humans [6]. Thiocyanate inhibits competitively the function of NIS in the thyroid and in salivary glands. Tobacco smoking is the main risk factor associated with chronic destructive periodontal disease and the risk is 5 to 20-fold elevated for a smoker compared to a never smoker [7]. In addition, the outcome of periodontal treatment is less favorable even unfavorable in smokers and treatment failures and relapses of disease are predominantly seen in smokers [7].

2. Materials and Methods

One hundred and twenty subjects were enrolled in the study. The groups were selected among the patients presented for treatment in the Department of Endodontics and Parodontology, at the University of Dental Medicine "Carol Davila", Bucharest, during 22.05.2014-14.05.2015: the control group, consisting of patients with no simple and complicated caries, and no periodontal disease (30 patients, 15 current smokers and 15 non-smokers), group I, consisting of patients with simple carious lesions (30 subjects, 15 smokers and 15 non-smokers), group II, which presented chronic marginal periodontitis (30 patients, 15 smokers and 15 non-smokers) and group III, with periapical pathology (30 subjects, 15 smokers and 15 non-smokers) (Table 1).

Salivary samples were collected to measure salivary iodine concentration. The samples were then frozen at -20°C and sent for analysis at the National Institute for Mother and Child Care "Alessandrescu - Rusescu", Bucharest. Salivary iodine concentration was determined by digestion with ammonium persulfate followed by Sandell – Kolthoff reaction. The values were expressed in mcg/L. The study was approved by the Local Ethics Committee. An informed consent from the subjects was obtained.

Determination of iodine concentration in saliva was based on a complex colorimetric Sandell – Kolthoff. Briefly, after treatment with ammonium persulfate and incubation at 92-97°C for 1 hour, the samples were exposed to arsenic acid and ceric ammonium sulfate activity. The obtained products were spectrophotometrically measurement at 420 nm; the color intensity is inversely proportional to the concentration obtained iodine.

Statistical analysis of data was done using an ANOVA analysis.

3. Results and discussion

In the salivary glands, NIS is highly expressed in the basolateral membranes of the majority of striated ducts; NIS expression in salivary glands is decreased during inflammation and tumor formation [8] (Figure 1).

![Fig. 1- A schematic representation of the human natrium iodide symporter, composed of 13 transmembrane domains.](image-url)
Smoking had an increasing effect on the concentration of thiocyanate and a decreasing effect on the content of iodide in saliva [9]. Iodine is the richest in electrons of the elements presently considered essential in the animal and human diets [3]. Inorganic iodide appears to be necessary for all living animal cells, but only the vertebrates have the thyroid gland and its iodinated hormones [3]. Inorganic iodide functions as an antioxidant, since it neutralizes hydrogen peroxide [10]. It was demonstrated that addition of iodine with thiocyanate increased the fungicidal and bactericidal effect of the lactoperoxidase system [11]. Thiocyanate reacts with hydrogen peroxide (H₂O₂) under the catalytic action of peroxidase enzyme producing hypothiocyanite, which has antibacterial properties and is less harmful to human cells than hydrogen peroxide [12]. Heavy smokers can show salivary thiocyanate concentrations as high as 6 mM and levels in non-smokers range from 0.5 to 2 mM, with an average of 1 mM [12].

Our data revealed that in the control group there have been noticed an expected statistically significant difference between the smokers group and the non-smokers group (average mean= 87.51 mcg/l) - Table 1. Moreover, in group 1, we found a statistically significant difference between smokers and non-smokers group (average mean=207.55 (p= 2.45) ), whereas in group 2 – 234.69 (p= 1.47) and in group 3- 194.2 (p= 1.31).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Non-smokers average (mcg/l) (60 samples)</th>
<th>Smokers average (mcg/l) (60 samples)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>97.41</td>
<td>19.8</td>
<td>87.51 (1.25)</td>
</tr>
<tr>
<td>Group I- Simple carious lesions</td>
<td>294.9</td>
<td>120.2</td>
<td>207.55 (2.45)</td>
</tr>
<tr>
<td>Group II- chronic marginal periodontitis</td>
<td>279.38</td>
<td>190</td>
<td>234.69 (1.47)</td>
</tr>
<tr>
<td>Group III- Apical parodontitis pathology</td>
<td>220.4</td>
<td>168</td>
<td>194.2 (1.31)</td>
</tr>
</tbody>
</table>

Our results confirm previous studies, which revealed that smoking had an increasing effect on the concentration of salivary thycyanate and a decreasing effect on the content of iodide in saliva [9]. As a consistence with other studies, were the smoking represented a major risk factor associated with chronic destructive periodontal disease [7], our results confirmed that the mean average of salivary iodide decreased significantly on group no II (chronic marginal periodontitis), in comparison with group no I (simple carious lesions) and III (apical parodontitis), where the levels were quite elevated.

4. Conclusion

The results from this study demonstrated in the control group, an average mean salivary iodide of 87.51 mcg/l, which can represent an useful measurement for further studies. However, it must be noticed the fact that salivary iodide levels were never performed within Romania territory until so far. In the studied groups, there was an expected statistically significant difference between the smokers and non-smokers groups; moreover, our findings have shown that the mean average of salivary iodide decreased significantly on group no II (chronic marginal periodontitis). In order to validate our current results, further studies on larger study groups should be performed.
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References