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Research Article

Effects of Hypertension with and without Smoking on Salivary Electrolytes Concentrations

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Abstract:

Background: Hypertension with smoking is a chronic medical condition that impacts the humans' health. It has been proved that it could be a significant risk factor for different disorders like brain damage, the lungs disease and has been related to the growth of oral diseases. However, there are few and conflicting research on its effect on salivary electrolytes concentrations.

Objectives: To assess the effect of hypertension with and without smoking on electrolyte concentrations in saliva and to identify its effect on normal oral balance.

Methods: A total number of 90 subjects included, which is comprised of (49) (54.4 %) males subjects and (41) (45.6 %) females subjects in the gender. They were divided into three groups, G1, G2 and G3 groups. Group 1 comprised 30 subjects of hypertension with smoking, Group 2 comprised 30 subjects of hypertension without smoking and Group 3 comprised 30 subjects of healthy non-smoking controls.

Results: Findings displayed a highly significant difference in concentration of calcium in saliva and there was no significant difference in potassium and sodium for the three groups. There was a significant difference of calcium in saliva concentration for all study group with respect to P-Value (0.000).

Conclusion: The salivary calcium concentration in the saliva can be affected by hypertension with smoking and the increase in salivary calcium levels might be a risk factor for the development of periodontal diseases.

Keywords: Calcium; Hypertension; Potassium; Salivary electrolytes; Smoking, Sodium.

Introduction:

Currently, hypertension is a widespread disease among elderly individuals. Hypertension has different impacts on oral hygiene like periodontal and gingival pathology (1). Moreover, hypertension can be defined as a systolic blood pressure (SBP) of 140 mm Hg or more, or a diastolic blood pressure (DBP) of 90 mm Hg respectively, the occurrence of that differs by age, race, and education (2). Hypertension involves different complications (3). These include periodontitis, gingivitis, oral candidiasis, and other associated complications that can appear in hypertensive individuals (4). In the same context, oral health plays a vital key in the common health status; we can prevent the development of several diseases through optimum oral health, which is significant not only at the oral cavity-specific level but also at the whole level of the body (5). However, poor oral health can impact blood pressure control in people diagnosed with hypertension (6). Salivary fluid is an exocrine secretion containing about 99% water, the rest of the fluid contains different salivary electrolytes (7) (sodium, potassium, and calcium) and proteins, enzymes immunoglobulin and different anti-microbial factors, mucosal glycoproteins, and traces of albumin (8). The total saliva indicates thecompleted mixture of fluids from the salivary glands, oral mucosa transudate, and the gingival fold as well as the mucus of the nasal cavity and pharynx, food remainders, non-adherent oral bacterial, desquamated epithelial and blood cells as well as traces of drugs (9). Smoking is a main cause of oral diseases that affect hypertension in human life. Several previous researchers have shown that exposure to passive smoking increases blood pressure for a small period and may be up to 24 hours. This can be explained by several biological impacts produced by exposure to passive smoking like vasoconstriction mediated by nicotine-induced catecholamine release, endothelial dysfunction, and decreased nitric oxide production (10).

Smoking greatly impacts salivary flow and its electrolyte composition; it differs with body posture and lighting status (11). The irritating impact of cigarettes raises glandular excretion and nicotine and causes severe morphologic and functional changes in the salivary glands (12). Cigarette smoking has been implicated as a cause of over three million deaths yearly (13). Heavy smokers are at raised risk of cardiovascular, gastrointestinal, respiratory diseases and several cancers (14). The alterations in serum electrolytes could produce life-threatening metabolic imbalances. Several oral and systemic situations can cause alterations in the flow and composition of saliva (15). The secretion of saliva can be classified into two stages. The first stage is secretion into the acinus of salivary glands and this fluid that was known primary secretion is not much different from extracellular fluid.

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The tobacco smoke has been found to change normal homeostasis of the oral cavity comprising the antioxidant and other protective systems of saliva. The mucosal alterations in smokers can also result from the drying effects of the mucosa, intraoral pH alterations, high intraoral temperatures, changed resistance to fungal, bacterial and viral infections, and local change of membrane barriers and immune responses (16).

Smoking usually causes a severe increase in heart rate and blood pressure and it may be found to be related to hypertensive crisis (17). The oral cavity is the first organ in the human body that can be exposed to the cigarette smoke. The tobacco smoke changes normal homeostasis of the oral cavity. It produces different byproducts like nitrosamine and nitrosonornicotine that may impact the cellular morphology (18). Different adverse cardiovascular events are related to tobacco intake and act as synergistic factors with hypertension and this raises the risk of coronary heart diseases beside dyslipidemia (19). The exact association between hypertension and smoking remains unclear, but paradoxically many different epidemiological studies have investigated high blood pressure in smokers than non-smokers (20). Smoking also often leads to cellular irritation and raised proliferative activity of cells, producing cellular changes (21).Human saliva comprises a large number of salivary electrolytes like potassium, sodium and calcium, which are easily controllable and can serve as a possible source of biomarkers to observe alterations, which appear under pathological situations (22). Saliva may act as a biological fluid for the identification of diagnostic and prognostic biomarkers (23). Several studies have documented conflicting findings of salivary composition in smoking. No significant difference was found salivary sodium, calcium, and potassium electrolyte compositions in smokers and non-smokers (24) while others showed a significant increase in serum levels of potassium and sodium in smoking (25) .Smoking males produce a highly significant stimulated saliva flow compared to non-smoking males (26). This study was aimed to evaluate the impact of hypertension with and without smoking on electrolyte concentration of saliva.

Martial and method:

This study was a cross-sectional respective study done on 90 apparently healthy subjects of whom 30 individuals had hypertension who were taking medical treatment (diovan) (80-160 mg) as single daily dose and they were smokers (G1), 30 individuals had hypertension and were taking medical treatment (diovan) (80-160 mg) but they were non-smokers (G2) and 30 individuals who were control (G3) without HT and smoking. The whole 90 subjects comprised 49 males and 41 females with age range of 30–72 years residing in Baquba teaching hospital / Diyala governorate the period during February to June 2022. Exclusion criteria included chronic alcohol drinking patient with oral or head and neck cancer, patient under chemotherapy or radiotherapy and diabetic patients. The details about smoking habits, dental and dietary habits and other information were evaluated via a questionnaire before gathering saliva for the measurement of salivary electrolytes (potassium, sodium, and calcium) by atomic absorption spectrometry (AAS) is very sensitive method of elemental analysis allowing the determination of metals in a variety of sample at the picogram level (27). This study was approved by Ministry of Health and the scientific committee \ College of Dentistry\ University of Baghdad.

Collection of saliva samples: The first procedure is to collect unstimulated whole saliva from all subjects included in the current study in the morning from 9-11 a.m. For healthy and unhealthy subjects, saliva was collected one time, which was achieved for hypertensive patients (90). Patients were requested to avoid any oral hygienic process and rinse their mouth with tap water to confirm the elimination of any food debris or contaminant. After that, patients were requested to create saliva in their mouth and to spit into a wide plastic tube. The gathering period was five minutes.

Computation of statistical analysis: The data were analyzed statistically utilizing statistical package for social science (SPSS) 26 version. Concentration difference between hypertensive patients with and without smoking compared to healthy control groups was achieved using one way ANOVA test. The level of statistical significance was applied at *P-value* < 0.05. One way ANOVA test using for analyzing the effect of concentration of salivary electrolytes (potassium, sodium and calcium) in saliva according to three groups. When P-value >0.05 that means no significant differences among groups were found, while P-value < 0.05 that represents the significant differences among groups were found. Mean with standard deviation were applied to find the measurements of each salivary electrolyte in saliva for the three groups G1, G2 and G3.

Results

Effect of salivary electrolytes in saliva

Table 1 shows the concentration of electrolytes in saliva according to each group.

Table1. The concentrations of electrolytes in saliva.

	Groups				
	Group1	Group2	Group3		
Salivary electrolyte type	Mean ± SD	Mean ± SD	Mean ± SD	F	P-Value
Potassium (mmol/L)	9.38 ± 0.88	10.74 ± 1.75	13.59 ± 0.95	±88.31	0.976
Sodium (mmol/L)	19.24 ± 1.15	17.88 ± 2.09	±15.47 ± 1.42	±40.15	0.714
Calcium (mmol/L)	1.86 ± 0.38	2.39 ± 0.53	±3.94 ± 0.67	±145.56	0.000

The results of potassium electrolyte concentration by comparing between groups (G1 and G2) with control (G3) revealed that the mean value of G1group was decreased. The highest mean value (13.59 mmol\L) of potassium was in G3 group while the lowest mean value (9.38) was in G1 group. On the other hand, the maximum standard deviation value (1.75) of potassium was in G2 group and the minimum standard deviation value (0.88) was in G1 group. The results of potassium electrolyte concentration for the three groups showed no significant difference (P-value=0.976). Figure 1 showed the salivary potassium concentration in the three groups. *No.* = 90; mean ± standard deviation (SD). Statistical comparisons showed no significant difference of potassium levels in the three groups *P-value* > 0.05.

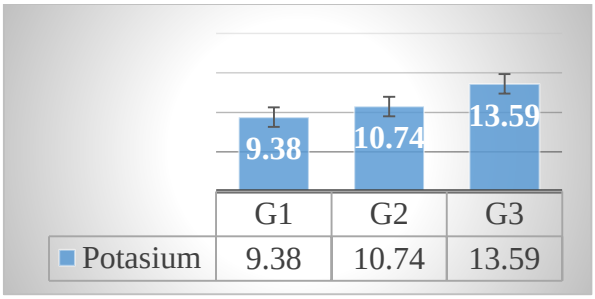

Figure 1. Potassium electrolyte concentration in the three groups.

According to the results in Table 1, there was a decrease in G3 for mean value (15.47) of sodium electrolyte compared to G1 (19.24) and G2 (17.88) groups. In the same context, the maximum standard deviation value (2.09) was displayed in G2 group and the minimum standard deviation value (1.15) in G1 group. A comparative analysis of sodium electrolyte concentration among the three groups showed no significant difference (P-Value=0.714). Figure 2 showed the salivary sodium concentration in the three groups. *No.* = 90; mean ± SD. Statistical comparisons showed no significant difference of sodium levels in the three groups *P-value* > 0.05.

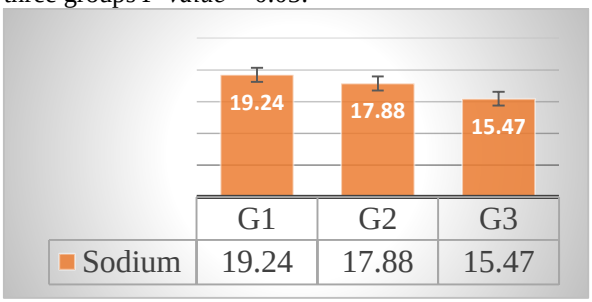

Figure 1. Sodium electrolyte concentration in the three groups.

Statistical findings showed that the mean and standard deviation values of calcium electrolyte (1.86 ± 0.38) in G1 group was smaller than G2 (2.39 ± 0.53) and G3 (3.94 ± 0.67) groups. That means, a significant decrease of calcium electrolyte concentration in the G1 group compared to G2 and G3 groups. For the comparison among the three groups, there was a highly significant difference of calcium electrolyte concentration (P-Value=0.000). Figure 3 showed the salivary calcium concentration in the three groups. *No.* = 90; mean ± SD. Statistical comparisons showed a significant difference of calcium levels in the three groups *P-value* < 0.05.

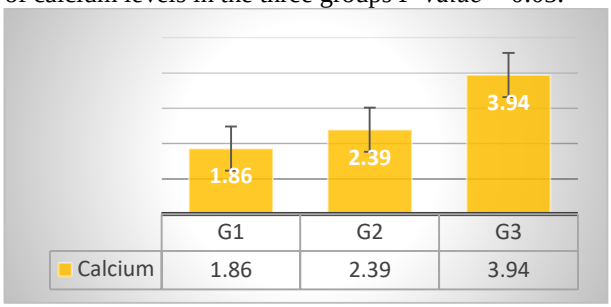

Figure 1. Calcium electrolyte concentration in the three groups.

Discussion:

The concentrations of potassium, sodium and calcium were different measurements of electrolytes in saliva (28). There are several potential characterizations included in the detected relations. Salivary electrolytes can be related to dietary factors, like reduced salt intake that raises salivary potassium, lowers salivary sodium and, as a result, a lowered sodium to potassium ratio. Similarly, the sodium to potassium ratio can be the effect of mineralocorticoid activity (29). Smoking does not only cause does not only cause systemic effects but can also cause pathological conditions in oral cavity (30). The heat from bearing cigarette can directly irritate the oral mucosa, causing damage to the salivary glands, thereby decrease salivary functions (31). There was a decrease in mean and standard deviation values of potassium electrolyte that was observed in hypertension with smoking compared to hypertension without smoking and control group. Moreover, potassium electrolyte was no significant difference on the saliva for the three groups according to the P-Value (0.976). However, a significantly decreased potassium electrolyte was determined as result from hypertension with smoking compared to hypertension without smoking and control group. The potassium electrolyte in saliva was affected by some diseases like hypertension (29). The content of the primary acinar secretion is adjusted on its passage via the duct system (32). The procedure is exposed to autonomic effects as the duct cells have parasympathetic and sympathetic innervations. Cholinergic stimulations decrease sodium resorption with a more variable impact on potassium content (33). The normal range (10.9-15.1 mmol/L) of potassium electrolyte was presented by Welz B, Sperling M, 2008 (34) that was near the mean value (13.59) of healthy control in current study. The mean value (9.38) of hypertension with smoking is less than the mean value (10.74) of hypertension without smoking. A similar study (35) in line with this study that reported potassium decreased with increased in

salivary flow rate of chronic tobacco users. This disagrees with the study (33) that showed a significant difference between hypertension and control group. Also (36) that reported smoking was related with higher concentration of salivary potassium. For sodium electrolyte, it can be observed that the increase in ratio of sodium electrolyte in saliva compared to potassium and calcium electrolytes in saliva due to the effects of dietary factors and heart disease like hypertension (29). However, a gradual decrease in sodium electrolyte was observed as progress from hypertension without smoking and control healthy group compared to hypertension with smoking. There was no significant difference of sodium electrolyte. This is attributed to cholinergic stimulations, which reduce sodium resorption (33). This was in agreement with Laine MA, et al., 2002 (36) who showed that smokers had greater concentration of salivary sodium. However, there was disagreement with the study Kallapur B, et al., 2013 (16), but it used quantitative estimation of sodium, potassium and total protein in saliva of diabetic smokers and non-smokers with different size sample study. The normal range (13.3-18.6 mmol/L) of sodium electrolyte was reported by Welz B, Sperling M, 2008 (34) which is in agreement with the mean value (15.47) of healthy control in the current study. The mean value (19.24) of hypertension with smoking is more than the mean value (17.88) of hypertension without smoking. Calcium electrolyte is known to be necessary for the normal function of different systems in the human body (33). It can be clearly observed that there were differences in calcium concentrations in saliva for the three groups according to P-value (0.000). Moreover, there was an increase in mean and standard deviation values in control group compared to hypertension with smoking and hypertension without smoking. Furthermore, a slight increase calcium electrolyte was detected as progress from hypertension without smoking and control healthy group compared to hypertension with smoking. These findings were in line with Labat C, Thul S, et al., 2018 (29). Nicotine can decrease estrogen and parathyroid hormone (PTH) levels. These hormones impact salivary calcium levels (37). Estrogen is recognized to play a role in changing the composition of saliva. Salivary calcium levels rise when estrogen levels decrease (38). This PTH hormone has a role in balancing calcium levels in the blood via releasing calcium from the bones into the blood (39). PTH will increase when calcium in the blood is reduced. Blood calcium levels will still decrease due to the lower calcium levels in saliva (40). The normal range (2.5-5.1 mmol/L) of calcium electrolyte was reported (34) that was matching with the mean value (3.94) of healthy controls in current study. The mean value (1.86) of hypertension with smoking was less than the mean value (2.39) of hypertension without smoking. This was in parallel with Bafghi AF, Tabrizi AG, Bakhshayi P, 2015 (24) who revealed that salivary calcium levels in smokers were less compared to non-smokers. In contrast, there was disagreement with a study of (41) which showed a significant increase in concentration of calcium in smokers saliva compared to non-smokers.

Conclusion

Saliva that is regularly looked upon as the "bloodstream of tooth" has different enzymes, micronutrients and macronutrients affecting dental caries. This study shows that hypertension with and without smoking caused considerably significant effects on the stability and regular secretion of salivary electrolytes with a highly significant different salivary concentrations of calcium compared to healthy control group, while there was no significant difference of potassium and sodium for the all groups. This could have adverse consequences on the regular homeostasis of the oral environment particularly according to raised salivary acidity that is an established predisposing factor to periodontitis. Moreover, the increase in salivary calcium levels that could be a risk factor for growth of periodontal diseases. Large-scale prospective studies comparing other salivary electrolytes are needed in the future.

Authors' declaration:-

We hereby confirm that all the Figures and Tables in the manuscript are ours. Besides, the Figures and images, which are not ours, have been given permission for re-publication attached with the manuscript.-Authors sign on ethical consideration's approval-Ethical Clearance: The project was approved by the local ethical committee in college of Dentistry\University of Baghdad according to the code number (464722) in 19/1/2022.

Conflicts of Interest: None

Funding: None

Authors' contributions:

Study conception & design: (*Maha A. Ahmed*). Literature search: (*Maha A. Ahmed*). Data acquisition: *Maha A. Ahmed*). Data analysis & interpretation: (*Maha A. Ahmed*). Manuscript preparation: (*Maha A. Ahmed &Layla S. Yas*). Manuscript editing & review: (*Maha A. Ahmed &Layla S. Yas*).

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اثار ارتفاع ضغط الدم مع وبدون التدخين على تراكيز العناصر المعدنيه اللعابيه

د. مها عبد الله اجمد / فرع طب الفم/ كلية الاسنان / جامعة بغداد
د.ليلى صبري ياس / فرع الباثولوجي/ كلية الاسنان / جامعة بغداد

الخلفية: ارتفاع ضغط الدم مع التدخين هو حالة طبية مزمنة تؤثر على صحة الإنسان. لقد ثبت أنه عامل خطر كبير لاضطرابات مختلفة مثل تلف الدماغ وأمراض الرئتين وقد ارتبط بتطور أمراض الفم. ومع ذلك ، هناك القليل من الأبحاث المتضاربة حول تأثيرها على بنية العناصر المعدنيه اللعابية.
الهدف: الهدف من هذه الدراسة هو تقييم تأثير ارتفاع ضغط الدم مع وبدون التدخين على تركيز العناصر المعدنيه في اللعاب ومعرفة تأثيره على التوازن الطبيعي للفم.
الطرق: العدد الإجمالي 90 مشارك ، والتي تضم (49) مشارك (54.4٪) للذكور و (41) مشارك(45.6٪) للإناث تم تقسيمهم إلى ثلاث مجموعات ، G1 و G2 و G3. تتألف المجموعة 1 من 30 شخصا من ارتفاع ضغط الدم مع التدخين ، وتتألف المجموعة 2 من 30 شخصا يعانون من ارتفاع ضغط الدم دون تدخين ، وتتألف المجموعة 3 من 30 شخصا من المجموعة الضابطة.
النتائج: أظهرت النتائج فرقا معنويا عاليا في تركيز الكالسيوم في اللعاب ولم يكن هناك فرق معنوي بين البوتاسيوم والصوديوم للثلاث مجموعات.
الخلاصة: تم الاستنتاج بان تركيز الكالسيوم في اللعاب يمكن أن يتأثر بارتفاع ضغط الدم مع التدخين وزيادة مستويات الكالسيوم اللعابي التي قد تكون عامل خطر للإصابة بأمراض اللثة.
الكلمات الداله:ارتفاع ضغط الدم,التدخين,كالسيوم,بوتاسيوم,صوديوم,العناصر المعدنيه اللعابيه.