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Effects of anti-asthmatic medications on oral health

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ABSTRACT

Aims of the study: To assess the oral health status (dental caries, dental plaque, gingival condition) and salivary pH among asthmatic patients using anti-asthmatics medications.

Materials and Methods: 76 asthmatic patients of both sexes ([2]0-30 years old) and 76 age and sex matched controls were studied. In asthmatic patients, the types, duration of medications were recorded. The dental health status including DMFT (decay, missing, filling teeth), plaque and gingival index were examined. In addition, measurements of unstimulated salivary pH were performed for both groups.

Results: The mean value of dental caries (DMFS), plaque index (Pl I), gingival index (GI) were found to be significantly higher among study group compared to control group at ($p<0.05$), while for salivary pH was significantly lower among study group compared to control at ($p<0.05$). The data analyzed with one way ANOVA test showed that mean value of DMFS and salivary pH of asthmatics were significantly affected by type of medication, while plaque and gingival index were statistically not significant in relation to anti-asthmatics medications. There was significant correlation between indices of dental caries and disease duration, while for Pl I, GI and pH no significant correlation were found.

Conclusions: Individuals with asthma have a higher caries prevalence, worse oral cleanliness, gingival condition and lower salivary pH compared to the control group, which can be due to use of anti-asthmatics medications. So a special preventive programs need to be designed for those patients.

Keywords: Caries experience, salivary pH, asthma, medications.

INTRODUCTION

Asthma affect about 1-18% of population in different countries.[1] The definition according to the Global Initiative for Asthma (GINA) is as follows: - "Asthma is a heterogeneous disease, usually characterized by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation".[1]

Several studies have shown several oral health conditions exist among asthmatic patients, especially an increased dental caries risk,[2,3]increased level of plaque accumulation and gingivitis.[4,5]. In addition it was found that asthmapharmacotherapy, may lead to a reduced salivary flow, changes in saliva composition, including pH alteration, which have harmful effects on teeth as they provide an optimal environment for the growth and proliferation of microorganisms responsible for dental caries (Streptococcus mutans and Lactobacilli) by reducing and modifying the protective effect of saliva, immune response alterations and an increased frequency of dental plaque and gingivitis when compared with healthy control.[2,3,6]

Asthma medication falls into two categories: quick relief medication and long term control medication. Quick relief medication comprises of short acting bronchodilators, systemic corticosteroids and anticholinergic drugs. While anti-inflammatory agents, long acting bronchodilators and leukotriene modifiers are categories as Long-term control medication. Most asthma drugs are inhaled usingvarious forms of inhalers or nebulizers which directly affects the bronchial smooth muscles after breathing it in through the mouth. Also, asthma medications are available as an oral tablet or oral liquid. [7]

The previous studies regarding dental caries in asthmatic patients showed the conflicting results. Some studies have shown the increased risk of dental caries in asthmatic patient compared to control group as well as a positive correlation between the duration of asthma and the caries indices[3, 8-11] whereas others failed to show any such association in these patients.[12]Although some studies reported that asthmatic patients had more plaque accumulation and gingivitis than healthy patients, others reported no difference in gingivitis prevalence and plaque formation.[6,13,14]

In summary, due to the conflicting study findings, our research is conducted on adult with asthma to assess their oral health condition and better understanding of the factors which may affect their oral health.

MATERIAL AND METHOD

The sample

The study was conducted during the period from the twenty of October; 2013 till the twenty of April; 2014. The study group consisted of (76) asthmatic patients with an age range between (20-30years) recorded according to the last birthday. [15] According to their medical records they were diagnosed to have asthma and under treatment for more than 6 months. Any patient with allergic disease or any other systemic disease in addition to asthma was excluded from this study.

A control group consisted of (76) healthy looking subject matching the study group with age and gender were examined, they accompanied patients in the same hospital to be from the same socioeconomic and educational level. All examined subjects were residence in Mosul city. Asthmatics subject were classified according to the type of the prescribed anti-asthmatic medication into four groups: group (1) short acting β_2-agonist inhalers (Salbutamol I), group(2) corticosteroid and short acting β_2-agonist inhalers (ICSS), group (3) combinations inhaler (corticosteroid and long acting β_2-agonist inhalers), group (4) leukotriene tablet.

Clinical examination:

Clinical examination was carried out for each patient and their control under a standardized condition following the recommendation of WHO, 2013.[15] Subjects were examined by seating on a portable chair fixed with an adjustable head rest; an adjustable portable light was used for illumination. General information's were recorded prior the examination included name, age, gender, area of residency, socio-economic state, brushing habits, frequency of snacking, type of asthmatics medications and duration of inhaler use.

Diagnoses of dental caries by DMFS index according to the criteria of WHO[20], plaque and gingival indices of Silness and Loe[16] were performed.While measuring the resting salivary pH with the use of premium quality plastic pH strips (Micro Essential Laboratory's pHydrion pH strips for saliva testing manufactured in the USA) For each patient examinations are made between 9:00 am and 11:00 am (at least two hour after breakfast) by putting the plastic pH strip at the floor of the mouth for 5 second and then match the color with the color chart.[17]

Data processing and analysis were carried out using SPSS package version 20, this includes Pairedt-test, Chi-square test, Student's t-test, Oneway ANOVA, Multiple comparisons Duncan's test, and Spearmaṅs correlation coefficients were applied. The confidence limit was accepted at 95% ($p<0.05$) and p values less than 0.01 were regarded as highly significant.

RESULTS

The samples

This research included a total of 152 subjects were participate in this study whose ages ranged from (20-30) years (mean 25.45± 3.56).The studied sample show no statistically significant difference between study and control group in

regard to gender distribution, brushing habits, frequency of snacking, socioeconomic status, gender and age, as shown in table (1)

Table (2) demonstrates that the mean value of dental caries (DMFS), plaque index (Pl I) and gingival index (GI) were found to be higher among study group compared to control group with statistically significant difference. While the mean value of unstimulated salivary pH was found to be significantly lower among study group compared to control group.In the study group a very weak positive non significant correlation was observed between Pl I and DMFS, a very weak negative non significant correlation was observed, between plaque index and pH. While a strong positive correlations was found with GI, the correlations was statistically significant at ($p<0.01$) as shown in table (3).In the control group weak positive correlation were observed between Pl I and caries-experience (DMFS), the correlations were statistically significant at ($p<0.01$). A weak negative non significant correlation was observed between Pl I and pH. While a significant moderate positive correlation was present with GI at ($p<0.01$) as shown in table (3).

In regard to the relations of DMFS and pH, in the study group, there was a weak negative significant correlation with pH, while in the control group; there was a strong negative significant correlation with pH as shown in table (4)

One way ANOVA analysis between DMFS and studied anti-asthmatic medications demonstrated a significant relationship at ($p\leq0.05$) among the means of (DMFS). Also the relation between pH and anti-asthmatic medications demonstrated a significant result as shown in table (5). The Duncan's multiple range test for DMFS showed that the Leukotriene had statistically no significant lower value of DMFS than the Salbutamol and both of them had significantly lower value than the ICSS which had significantly the highest value. While no significant difference was observed between Combination and Leukotriene, Salbutamol and ICSS. The specific Duncan's multiple range tests for pH in table (5) showed that the ICSS had no significantly lower value of pH than the salbutamol and combination and all of them had significantly lower value than the Leukotriene which had significantly the highest value. While the one way ANOVA test show statistically no significant difference at ($p\leq0.05$) among the means of (PI, GI).

Table (6) demonstrates a significant weak positive correlation between the duration of drug intake and DMFS. While non-significant very weak positive correlations was observed with (PI, GI, DS), also non-significant very weak negative correlation was observed with pH.

Table (1): distribution of adults according to gender, frequency of tooth brushing, frequency of snacking, age and socioeconomic status

Components		Study group (N=76)		Control group (N=76)		p-value
		N.	%	N.	%	
Gender	Male	34	44.7	34	44.7	1.00
	Female	42	55.3	42	55.3	
Brushing Habits	Never	10	13.2	9	11.8	0.553
	< once a day	18	23.7	24	31.6	
	Once a day	48	63.2	43	56.6	
Snacking	< once a day	26	34.2	24	31.6	0.265
	Once a day	12	15.8	22	28.9	
	Twice a day	27	35.5	21	27.6	
	3≤ day	11	14.5	9	11.8	
Age	20-25 year	27	35.5	32	42.1	0.405
	25-30 year	49	64.5	44	57.9	
Socioeconomic	Low	25	32.9	26	34.2	0.874
	Moderate	30	39.5	27	35.5	
	High	21	27.6	23	30.3	

Significant at $p<0.05$

Table (2): Caries experience, the Plaque and GI Indices, resting Salivary pH (mean and standard deviation) among study and control groups.

Components	Study group		Control		t-value	p-value
	Mean	±SD	Mean	±SD		
DMFS	23.49	12.259	13.76	13.088	4.727	0.000*****
Pl	1.069	0.578	0.524	0.563	5.886	0.000*
GI	0.545	0.531	0.163	0.332	5.321	0.000*
pH	6.005	0.359	6.920	0.591	-11.526	0.000*****

*Significant at p<0.05, df=150 for adult.

Table (3): Correlation coefficient between Pl I and caries experience among study and control groups in adult and children.

Variable	Study group		Control group	
	r	**P**	**r**	**P**
DMFS	0.089	0.445	0.336**	0.003
pH	-0.106	0.362	-0.173	0.134
GI	0.625**	0.000	0.490**	0.000

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05 level

Table (4): the correlation coefficient between caries experience and salivary pH in the study and control groups for adults and children.

Variable		Study group		Control group	
		r	P	R	p
pH	**DS**	-0.268*****	0.019	-0.561******	0.000
	DMFS	-0.291*****	0.011	-0.686******	0.000

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05 level

Table (5): Descriptive statistic, ANOVA, and Duncan's test of dental caries experience, plaque index, gingival index and pH for asthmatic taking anti-asthmatic medications.

Variable	Medications*	N.	Mean	Std. Deviation	Duncan's Group**	F	Sig.***
DMFS	Salbutamol I.	20	20.25	12.515	A	4.428	0.007*
	ICSS	20	30.30	12.144	B		
	Combination	21	24.57	12.687	AB		
	Leukotriene	15	17.20	6.085	A		
PI	Salbutamol I.	20	1.210	0.586	A	0.738	0.533
	ICSS	20	1.052	0.607	A		
	Combination	21	0.941	0.668	A		
	Leukotriene	15	1.087	0.360	A		
GI	Salbutamol I.	20	0.715	0.588	B	2.671	0.054
	ICSS	20	0.493	0.387	AB		
	Combination	21	0.643	0.671	B		
	Leukotriene	15	0.252	0.203	A		
pH	Salbutamol I.	20	5.930	0.288	A	4.194	0.009*
	ICSS	20	5.915	0.296	A		
	Combination	21	5.967	0.333	A		
	Leukotriene	15	6.280	0.444	B		

*Salbutamol I=Salbutamol inhaler, ICSS =inhaled corticosteroid + Salbutamol inhaler, combination = long acting β_2 agonist + corticosteroid (Fluticasone and Salmeterol)
**Different letters mean significant difference at $P \leq 0.05$.
****Significant at $p<0.05$.

Table (6): The Correlation - Coefficient between the duration of medications intake and other variables

Duration		
Variables	**R**	**P**
pH	-0.131	0.260
DS	0.116	0.320
DMFS	0.306**	0.007

**Correlation is significant at the 0.01 level
*Correlation is significant at the 0.05 level

DISCUSSION

Asthma and the use of asthma medication have long been suggested to potentially increase the risk of oral and dental health problem, but the results of individual studies have been inconclusive. [5, 18]. In the present study was found a higher statistical significant DMFS values among young adult asthmatic patients compared to control group. This difference in caries prevalence was in agreement with several studies.[5,9,11] While opposite results were found by other studies.[12,13,19]

The possible cause of highly significant caries experience can be explained as seen in previous studies as a relationship between the type of anti-asthmatics medications,[20,21] salivary acidic pH and dental caries, as shown in the present study there were a weak negative significant correlation between salivary pH and caries experience (DMFS) in asthmatics group and a moderate negative significant correlation in control, also this study revealed a very weak positive non-significant correlation between a plaque index and caries experience in asthmatics and a weak positive significant correlations in control group, the poor oral hygiene status with asthma increased tendency to dental caries development.[19]

According to the type of medications the result of one way ANOVA test for DMFS in the present study showed there was a significant difference and ongoing to the table of Duncan's multiple range test which showed that the highest mean was ICS (corticosteroid + B_2-agonist inhaler) that causes this significant difference between medications in caries

experience. Many studies support our conclusion that therapy with β_2-agonists and corticosteroids both together are associated with changes in oral health in asthmatic, the lowest levels of salivary flow rate and buffering capacity as well as the highest levels of Streptococcus mutans and lactobacilli. All of that can explain why they had the highest mean of caries-experience in our study.[9,22]

It has been suggested that prolonged use of β_2-agonists is associated with diminished salivary production and secretion, reduced pH of saliva and plaque, and thus an increased frequency of caries.[21] Since salivary buffering capacity has been lost, an acidic environment is encouraged and persists longer. This in turn encourages growth of aciduric bacteria such as lactobacilli and Streptococcus mutants,[3] which grow and continue to metabolize carbohydrate in the low pH environment. The stage is set for uncontrolled carious attack.[23,24]

Another factor related to an increase in caries risk in asthmatics in the regular use of inhaled corticosteroids medication, they are weak organic acids and generally not metabolized by oral bacteria. However, they pose a pH threat when sugar-based inhalers are used, the saliva changing and agents included in the composition of medical agents that maintain a low pH and favour the adherence of cariogenic bacteria.[25] In addition to the medication effects on dental caries was also documented.[8-11,26] Also the chronic use of corticosteroids could be hypothesised to interfere in the process of mineralization of teeth during development and on the demineralization–remineralization balance after eruption.[27]

Accordingly the majority of the individuals in the present study used the inhaler at bedtime and morning time. The cariogenic activity increases during the night due to lower salivary flow, lower buffer capacity and lack of masticatory movements.[8]

This risk might therefore be further augmented with increased association between asthma, asthmatics medications and dental caries experience in the presence of poor oral hygiene and lack of dental care as observed in the present findings.

The plaque index was higher in asthmatic than control group. There is a significant difference observed for the Pl I between asthmatics and control group this finding was in agreement with several studies.[4,14,26]
While other researchers did not observe differences in oral hygiene patterns between the asthma group and the respective controls,[3,28] but Hyyppa et al. (1979)[29] found asthmatics had lower plaque scores than controls. The present study also showed a very weak negative correlation between Pl I and pH among study group and weak negative correlation among control and the correlation was not significant in both groups. It appears that the oral health of asthmatics is affected in different age groups, from early childhood to young adulthood by medications effects, reduce salivary flow which can be from impair salivary gland function, can cause dehydration of the alveolar mucosa, decrease salivary pH, higher frequency of mouth breathing, as well as various immunological factors in asthmatics has been linked to more plaque.[4,5] Higher plaque score can partially explain more gingivitis among asthmatic patients. In the present studies, the asthma group had more gingival inflammation than their healthy controls this in agreement with other studies.[4,5,23]

Mehta et al. (2009)[4] and Stensson et al. (2011),[5] who reported more severe gingivitis in asthmatics compared with healthy controls. This can be explained by an altered immune response, reduce salivary flow and the dehydration of alveolar mucosa due to mouth breathing which may also lead to more plaque and less saliva. The result of one way ANOVA test for plaque and gingival index showed there were no significant difference between the studied anti-asthmatics medications

In the present study we found significant decrease in salivary pH among asthmatics compare to control. Regarding unstimulated salivary pH, significantly lower and more acidic pH values. This finding was in agreement with the result of different studies[5,26,30] and in contrast with other scientists, such as Tootla et al. (2004)[25]also found that none of the inhalers were able to demonstrate an acidogenic response that affected substantially oral environment.[3,31]

The result of one way ANOVA test for unstimulated salivary pH showed a significant difference between anti-asthmatics medications and ongoing to the table of Duncan's multiple range test for medications showed that inhalers (combination, Salbutamol I, ICS) record the lower value respectively and leukotriene record the highest which causes difference between the studied medications. Inhalation of different combinations of corticosteroids and long-acting β_2 agonist inhaler decreases initial salivary and plaque pH in young adult, especially on first and fifth minute. It is followed by a tendency of increase of pH values up to the 30th minute without reaching the initial levels[25,26,32] We assume that the changes in acidity can be explained with the local effect of inhaled β_2-against on salivary glands secretion. The reduced salivary flow rate influences negatively its buffering and clearing abilities,[23]drug gustatory correctors, such as sucrose, also drug were acidic, these sweeteners along with the low endogenous pH form highly

cariogenic formulation, gastro-esophageal reflux in some asthmatics patients[33]and increased consumption of drinks to compensate for oral dehydration, often drinks with a low pH[2] but Ersin et al. (2006)[3] found that the type of medication does not affect the salivary pH and this disagree with the present study finding.

A weak positive significant correlation was observed between the duration of drug intake and DMFS. This in line with Milano et al. (2006)[9] were they found a significant positive relationship between increased frequency of asthma medication and incidence of dental caries.[24,30]Very weak positive non significant correlations were observed between the duration of drug intake with Pl I and GI. Ghulam (2007)[13] also reported a positive not significant correlation between the duration of drug intake and gingival index. A very weak negative non significant correlation was observed between the duration of drug intake and pH. The regular use of inhaled medication which have been found to decrease salivary and plaque pH when inhaled.[8,10,25] However, other studies did not recognize any connection between the period of exposure to medication and the prevalence of caries.[3,11]

CONCLUSIONS

The prevalence of dental caries was significantly higher in asthmatics subject compared to control group and asthmatics taking corticosteroid and β_2- agonist inhaler record the highest mean, asthmatics record the higher plaque and gingival index, also lower resting salivary pH compared to healthy control group. Studied inhalers medications record the lower salivary pH. While duration was positively significant with DMFS index. Finally dental health education is mandatory in asthmatic patients especially in the younger age andshould receive intensive preventive programs, including oral hygiene instruction, dietary advice and regular topical fluoride treatments.

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