Possible effects of chemical weapons used in Halabja martyr city at 16th march 1988 on developing oral and dental tissues

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ABSTRACT

Background: The development of oral and dental tissue is a complex process regulated by genes that are very sensitive to disturbances in the environment. Although many studies were conducted in different parts of Iraq, Halabja city is different; it had been subjected to chemical weapons in 1988, that if not produce death, it is expected to produce developmental anomalies.

Methods and methods: A total of 457 persons were selected and divided to include 3 age groups, those born before 1971 (control group), those who were in utero during 1988 (group2), and those born in 1993 in Halabja city (group3). Full extra-oral and intra-oral examination was carried out to diagnose any existing anomalies.

Results: Oro-dental anomalies were associated with history of parents' exposure to chemical weapons (r = 0.3); no sex difference was detected. Clinically missing teeth and retained deciduous teeth were the predominant anomalies(11%) and correlated with history of parents' exposure to chemical weapons predominantly in group2 (r=0.24). Enamel hypoplasia and local enamel opacities observed in 9.85%; macroglossia, fissured tongue, and ankyloglossia were seen in 6.13%.

Conclusion: History of the exposure to chemical weapons effects teeth number, structure, and tongue anomalies. Clinically missing teeth and retained deciduous teeth were the predominant anomalies.

Key words: Halabja city, chemical weapons, developmental anomalies. J Bagh Coll Dentistry 2010; 22(1):25-30.

INTRODUCTION

Dental anomalies are caused by complex interactions between genetic, epigenetic and environmental factors during the long process of dental development. This process is multifactorial, multilevel, multidimensional and progressive over time [1]. Nevertheless, teeth anomalies are uncommon [2]. Several studies were performed to register their prevalence in various Iraqi cities [3-5], Halabja is a distinguished city in the north of Iraq. It had been subjected to multiple chemical agents (mustard gas, nerve agent; sarin, tabun and VX) during the war between Iran and Iraq in 1988 that expected to produce anomalies [6]. These gases are potent chemical vesicant warfare agents that remain significant military and civilian threat, their effect is dose dependent, and causes either airway inflammation and pulmonary damage or a life threatening cholinergic crisis [7]. Prolonged exposure to small amounts of mustard gas was reported to cause a slight chromosomal change [8,9].

The aim of the study was to identify the types and percentage of oral and dental tissue anomalies in Halabja in relation to the events of chemical weapons used in 1988.

MATERIALS AND METHODS

A total of 457 persons from Halabja martyr city were randomly selected to fit into 3 age groups, according to their birthday; before, during and after 1988 as follow: The first age group (58 person, 37 males and 21 females) included all possible persons examined in the schools and institutes born in Halabja before 1971 (i:e in 1988 they were 18 years old, so the teeth and soft tissues had full developed and considered as a control group to compare the effect of chemical weapon). The second selected group (154 person; 67 males and 87 females) including all possible existing person in Halabja, who born between 16/3/1988 to 25/12/1988 (they were in-utero during chemical bombardment). The third group (245 persons; 70 males, and 175 females) included those born in Halabja in 1993, to represent the possible late effect of the chemical weapon, as the people return to their city in 1992 at the end of the war.

An official permission from the Halabja's General Directorate of Education and Institutions in the city was obtained to perform examination in

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the schools and institutions. Personal information and a thorough history of their mothers' exposure to the chemical weapons (MECW) were reported. Teeth were examined (use the Modified Developmental Defect of Enamel Index)[10], after wrapping them with cotton to remove debris and dental plaque, using sterilized dental probe and mirror, under strong artificial light and any existing soft tissue anomalies were all recorded in a case sheet.

The calculated data was tabulated regarding the age group, sex, MECW. Chi-square test and Spearman's correlation were applied to test differences and correlations among the parameters.

RESULTS

Out of the 457 examined persons (i:e, affected and non affected persons) 36.54% had a history MECW (13.35% males and 23% females) with no sex variation. Oro-dental developmental anomalies were reported in 129 persons (28.22%) (9.85% male and 18.1% female) with significant high percentage of them 59.68% had history of MECW, $p<0.001$, $r = 0.3$, (Figure 1 and table 1). The reported anomalies were 10.3% , 24.7% and 34.7% in the 1st , 2nd and 3rd groups respectively with a prominent female involvement in 1st group and no sex variation in the remaining other groups. The presence of a history of mother exposure to chemical weapons was 86.8% and 51.8% in 2nd and 3rd groups respectively (table 1).

Tooth anomalies:

Anomalies in teeth number and eruption comprised 11% of the sample, they include 3.28% clinically missing permanent teeth and 7.66% retained deciduous teeth, the latter was predominantly in females. They were significantly correlated with the history of MECW ($r = 0.24$; $p = 0.01$) (Figure 2 and Table 2). The largest frequency of this anomaly was reported in the 2rd group (5.84%) with (100%) history of MECW (table 2). The upper lateral incisor was the most affected tooth (44%) equally distributed between males and females, followed by maxillary canine (37%). Interestedly, we see 66.7% of the cases with symmetrical bilateral clinically missing teeth with history of MECW.

Retention of deciduous teeth was seen only in the 3rd age group. It comprised 14.3% with no sex variation, 54.3% of them had parents exposed to chemical weapons (table 2). Females had multiple retained deciduous teeth. The primary lower second molar (38.4%), followed by deciduous upper canine (24.7%) were the more frequently retained teeth.

Talon cusp represents 0.87% of the total sample. No such anomaly was reported in the 1st group and all the cases affected the canine.

Considering the anomalies in tooth size, microdontia was reported in 1.75% with no differences among studied groups (table 2). The upper lateral incisors was more affected and predominantly in females (87.5%). Microdontia seems to be associated with other dental anomalies.

Anomalies in teeth structure (enamel hypoplasia and hypocalcification) represent 9.85%of the total sample with weak correlation with history of MECW. The 3rd age group was the most affected one and predominantly in females.

Enamel hypoplasia alone comprised 3.06% of total sample (figure 2). The largest percentage was reported in the 3rd group with female predilection and most of them (70%) had family exposed to the chemical weapons. On the other hand, enamel opacities represent 6.78% of the total sample (figure 2) also with predominant female involvement and 91% of the cases had history of MECW. It presents in all age groups (table 2).

Soft tissue & other anomalies

Tongue anomalies in general represent 6.13%, it had a weak correlation with history of MECW, $r = 0.11$, $p = 0.02$. Macroglossia alone comprised 0.66%of the total sample. It was seen only in 2nd age group (1.95%), most of them had a history of MECW (table 2). While fissured tongue represents 1.31% of the total sample (figure 2). Most of them in 2nd group 2.6%. No case was seen in the1st group. On the other hand, ankyloglossia accounts 4.16% of the total sample (3.45%, 3.25% and 4.9% in the 1st ,2nd and 3rd groups respectively). All cases reported in 2nd and most of the 3rd group had history of MECW (table 2). Commissural lip pits and cleft lip and palate both observed in 0.22% for each, in females.

DISCUSSION

This study remarks that developmental oro-dental anomalies in Halabja martyr city may be associated with exposure to chemical weapons with no sex variation. These anomalies were evident in 28.22% and more predominantly in those born during 1993 inside the Halabja city (35.1%) thus the effect of chemical weapons seems to increase the incidence of these anomalies nearly twice to three times than that before the time of bombardment (10.3% to 24.7% to 34.7%).

Although the percentage of affected persons with history of parent's exposed were reduced in the last group (0% to 87% to 52%). This may attributed to the persisting effects of toxic gases in

the environment in similar manner to the sub-lethal effects of organophosphates insecticides (poison gases: Sarin and tuban types) which persist for longer time than the offending chemical [9]. Yet, not every exposed parent had affected offspring and vice versa, this pursues the avenues of gene-environment interactions, which are incompletely understood [1,2].

Tooth anomalies:

The existence of clinically missing teeth may indicate failure of teeth to develop or erupt. Thus possibly involve early stages of tooth genesis or later stages of root formation. Yet this anomaly in Halabja was less than that found in Sulaimani city [5] and no case was reported in Baghdad city [3]. On the other hand Japanese children living in area exposed to chemical and nuclear weapons had reported to have less missing teeth (2.38%) than our study, but they indicated tendency of increasing its incidence [11,12]. On the other hand, clinically missing teeth in Halabja city was significantly correlated with the exposure to the chemicals. Thus one may suggest that failure of teeth to develop or erupt could be related to the effect of chemical weapons on the early stages of tooth genesis and later stages of root formation. Nevertheless more specified study with radiographical investigation may declare this point.

The most missing tooth was the maxillary lateral incisor followed by maxillary canine. This is in line to what is published previously after excluding the third molars [1,5], although other population showed the maxillary canine to be in the top of the list [13].

As the permanent precursors develop and begin to erupt, they influence the pattern of resorption of the deciduous teeth and their exfoliation. In human this process starts at 7.4 years in sequential order that last for 11.9 years when the last tooth (lower second molar in males) shed and it is earlier in females than males. If deciduous teeth are retained beyond time of exfoliation, they cause delay in eruption of permanent teeth [14]. Interestingly, only citizen born in 1993 in Halabja had retention of their deciduous teeth. The absence of radiograph may produce limitations in considering these cases as anomaly. Nevertheless missing or impaction of the permanent may be the cause, but at time of our examination, the pupils were14 years old which is beyond the age of eruption of permanent teeth by approximately 2 years, so this may consider as an abnormal process rather than a normal physiological delay. No case was reported in Baghdad [3] or in Sulaimani [5] cities. Primary lower second molar was the most affected tooth found in this series unlike previous study in which the primary upper canine was the offended tooth [13].

On the other hand, Talon cusp is an asymptomatic and incidental dental finding during routine dental examination, its frequency in the population ranges from less than 1%- 8% [14]. The incidence of Talon cusp in Halabja city is nearly equal to that reported in Sulaimani city [5], and greater than that found in Baghdad [3], Mosul cities [4] and other countries [11,13] but it was less than that observed in other studies [15,16]. Since this anomaly was not found in people born before 1971, and in the second age group (1988) is associated with history of parents' chemical exposure, this also may remark to the early effect of chemical weapons on morpho-differentiation. .

The prevalence of isolated microdontia is not uncommon [14]. Its occurrence in Halabja city is similar to that reported in Turkish population [17], but it was more frequently in females. There was no case reported in Sulaimani [5] and Baghdad [3] cities.

Lastly, anomalies in enamel structure reflect disturbances in ameloblasts' secretions that influenced by many environment and systemic disturbances [18]. Such enamel defects represent the 2nd most common anomalies that observed predominantly in females in Halabja city. It correlated significantly with history of MECW. However, the percentage was lower than that reported in primary schools children of Sulaimani (28.9%) [5], Baghdad city (42.7%) [3] and Iranian junior high school children (32.7%) [19]. This may be attributed on one hand, to the nature of water supply in Halabja city, which comes from lakes and fountains from the surrounding mountains which are rich in minerals [5] and on the other hand, variation in sampling techniques, and difference in diagnostic criteria. However, the results of this study preliminary reflect that chemical weapons seems to related with the increase of the frequency of this anomaly in those born in 1993, and it needs further investigations to declare this point.

Soft tissue and other anomalies

The frequency of tongue anomalies was more frequently seen in Halabja's population than in Sulaimani [5] and Ankara [20] and less than that observed in Baghdad city [3].

Macroglossia was only seen in the those born in 1988 and no case was reported in Baghdad or Sulaimani cities [3,5]. It was more than that reported in Turkish population (1.24%) [21]. Two third of the reported cases had history of MECW; this could be attributed in part to the late effect of chemical. On the other hand, the frequency of

fissured tongue in Halaba's population is nearly similar to the findings of Saudi Arabia [22] but lesser than the results of Baghdad [3], Mosul [4], and Sulaimani [5]. Although the condition reported to be increase with age [14], nevertheless, in our study it was seen in adolescents and young.

The result of ankyloglossia frequency in Halabja is high and disagrees with published reports of other Iraqi governorates [3-5], but it is located within the maximum normal limit [14]. This can be attributed to the immediate and late effects of the exposure to chemical weapons. On the contrary commissural lip was lesser than the results of above studies [3-5].

Cleft lip with or without cleft palate in general has an occurrence of 1 in 500 to 2,500 live births worldwide which mean (0.2%- 0.04%) of live births [23] which is in line with our results. The mother of affected person in 2nd group had subjected severely to the chemical weapons and she is still suffering now from skin and respiratory problems, and all of her family members especially those who born after her are suffering from cleft lip and palate and other systemic problems.

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Table 1: The percentage distribution of the persons with history of parent exposed to chemical weapons, persons having developmental anomalies and persons with both conditions, in different age groups.

	Group1	Group2	Group3	Total
persons with history of parent exposed to chemical weapons	0	53.6	34.7	36.54
persons with developmental anomalies	10.3	24.7	34.7	28.22
persons with developmental anomalies and exposed parents	0	86.8	51.8	59.68

Table 2: The percentage distribution of different oral and dental developmental anomalies in examined groups in relation to history of exposure of parents to chemical weapons

Type of anomalies			Group1		Group2		Group3	
			No.	%	No.	%	No.	%
Number & eruption 11%	Clinically missing permanent teeth	Affected persons	1	1.72	9	5.84	5	2.04
		With exposed parents	0	0	9	100	3	60
	Retention of deciduous teeth	Affected persons					35	14.3
		With exposed parents					19	54.3
Shape 0.87%	Talon cusp	Affected persons			2	1.3	2	0.82
		With exposed parents			2	100	0	0
Size 1.75%	Microdontia	Affected persons	1	1.72	3	1.95	4	1.63
		With exposed parents	0	0	3	100	0	0
Enamel structure 9.85%	Enamel hypoplasia	Affected persons	1	1.72	3	1.95	10	4.08
		With exposed parents	0	0	2	66.7	7	70
	Enamel opacity	Affected persons	1	1.72	11	7.14	19	4.9
		With exposed parents	0	0	10	91	10	75
Tongue 6.13%	Macroglosia	Affected persons			3	1.95		
		With exposed parents			2	66.7		
	Fissure tongue	Affected persons			4	2.6	2	0.82
		With exposed parents			2	50	1	50
	Ankyloglossia	Affected persons	2	3.45	5	3.25	12	4.9
		With exposed parents	0	0	5	100	9	75
Lip 0.44%	Lip pit	Affected persons					1	0.41
		With exposed parents					0	0
	cleft	Affected persons			1	0.65		
		With exposed parents			1	100		

Figure 1: The frequency distribution of developmental anomalies in relation to sex and the history of parent exposed to chemical weapons.

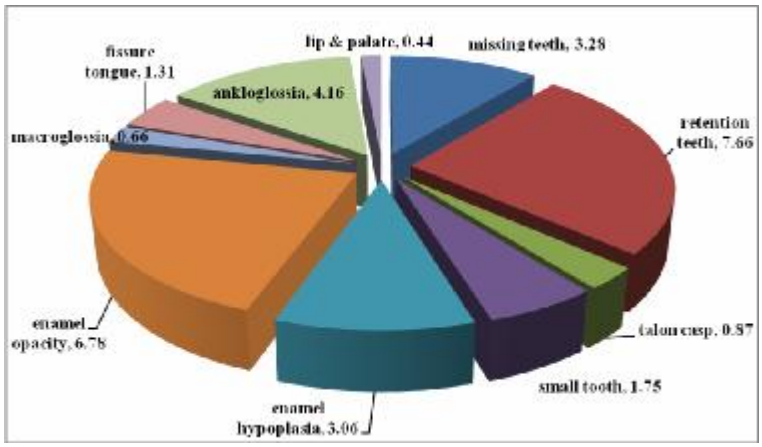

Figure 2: The percentage distribution of different types of oral and dental developmental anomalies reported in Halabja