EPIDEMIOLOGICAL STUDY OF GOITRE IN ENDEMIC FLUOROSIS DISTRICT OF GUJARAT

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SUMMARY: Soft tissue fluoride toxicity is well established. Several animal and human studies of the effect of fluoride on the thyroid gland have shown conflicting results. Endemic fluorosis and goitre are widespread in India with considerable overlapping in different geographical zones. We examined 22,276 individuals for presence of goitre and dental fluorosis and estimated the fluoride and iodine content of their drinking water. Overall goitre and dental fluorosis prevalences were 14.0% and 12.2%, respectively, and were significantly and positively correlated. No significant relationship was observed between water iodine level and goitre. In the study area only 0.3% of cases were visible goitre (Grade-II and above) and all goitre cases were euthyroid. This suggests that fluoride-induced goitres are brought about by anatomical or structural changes rather than functional changes.

Key words: Dental fluorosis; Goitre.

Introduction

Soft tissue involvement in fluoride toxicity is now well established. In the past, the toxic effect of fluoride on the thyroid gland was suspected, based on clinical experience in the treatment of Grave's disease (1). A high prevalence of goitre has been observed in countries where skeletal fluorosis is endemic (2). Controversy still exists because several animal experiments and human studies have shown conflicting results (1).

In India endemic fluorosis exists in 15 States and the problem of endemic goitre occurs in 12 States, with significant overlapping of the problem in some regions. Such widespread co-existence provides an opportunity to conduct epidemiological studies, in order to better understand the interactions of the trace elements involved, the effects on human health, and methods of control and prevention.

Materials and Methods

The Amreli District in the Saurashtra region of the State of Gujarat, on the west coast of India, has ten administrative blocks, two with hilly terrain. The major source of drinking water is ground water.

Our clinical examination of 10,029 residents by a house to house survey and 12,247 children by a school survey, covering 1% of the total population and 5% of school children of randomly selected villages, conformed to WHO recommendations for a goitre survey (3). Water samples were collected from all drinking water sources. Fluoride and iodine estimations were carried out, with an ion-specific electrode and titration method, respectively.

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Results and Discussion

Amreli District is one of the first identified endemic fluorosis districts in Gujarat State. The overall district prevalence of dental fluorosis was 12.2% and of goitre 14.0%. Age specific prevalences of dental fluorosis and goitre are shown in Table 1. Both problems were predominant in school children and young adults.

Dental fluorosis prevalence ranged from 6.0 to 59.0%, and goitre from 9.5 to 37.5%, in some blocks of the district. Distribution of blocks according to dental fluorosis and goitre prevalence is shown in Table 2. Only one block had goitre prevalence < 10%. In two blocks with more than 20% goitre prevalence dental fluorosis prevalence was more than 50%. There was a significant positive correlation between prevalence of goitre and dental fluorosis in the study area ($r = +0.4926$, $p<0.001$).

Iodine deficiency is the major cause of endemic goitre (more than 10% prevalence) in India. In the study area all but one of the blocks had goitre prevalence conforming to WHO criteria for endemic goitre (3). An earlier study of goitre and associated health consequences in Surat District of Gujarat State (4) revealed endemic goitre in regions with less than 20 µg/litre water iodine level. In the present study endemic goitre was present even in six District blocks with water iodine levels greater than 20 µg/litre. Moreover, there was no significant correlation between water iodine level and goitre prevalence ($r = 0.1443$, $p>0.05$).

The significant correlation between prevalences of goitre and dental fluorosis, and the absence of significant negative correlation between water iodine level and goitre prevalence, indicate a probable role of fluoride toxicity in the development of goitre cases. This conclusion is further supported by the fact that dietary patterns were uniform in the study area and the use of goitrogen containing foods was not predominant in any block.

In the study area there was no village with a water fluoride level less than 1 ppm (the "safe" limit for India) and a water iodine level less than 10 µg/litre. In regions with a normal iodine environment (water iodine level more than 20 µg/litre), goitre prevalence was significantly higher in regions with more than 2 ppm water fluoride level (27.8%) than in regions with less than 2 ppm water fluoride level (17.1%). The present study thus indicates that fluoride toxicity in a normal iodine environment can cause a goitre problem. A study in Andhra Pradesh has also revealed direct correlation between water fluoride level and goitre in the 14-17 years age group (5), while a study in 17 Himalayan villages showed a positive correlation between goitre prevalence and water fluoride level in the presence of uniformly low water iodine levels (6).

According to Stanburry's classification of goitre (7) the prevalence of visible goitre (Grade-II and higher) was only 0.3% in the study area. In districts of Gujarat State with endemic goitre due to iodine deficiency visible goitre prevalence was 5.8%. Thus there were more early goitre cases in the study area than is usually seen in goitre endemic areas.

Goitre cases were clinically euthyroid in the present study, and cases with clinical manifestations suggestive of cretinism were significantly lower (0.1%) than in the endemic goitre zone (0.9%) in Gujarat State (8). These observations indicate

that goitre due to fluoride toxicity does not have functional changes and does not affect the hormonal profile in the community under study. Large scale demographic surveys in U.S.A. and Great Britain have also indicated that drinking water fluoride does not impair thyroid function (1).

Attempts have been made by several workers to study the mode of action of fluoride on the thyroid gland. Experimental studies in animals have suggested that high fluoride intake causes hypertrophy of parafollicular cells and high glycerophosphate dehydrogenase activity (9), increased lipid component, total lipids and triglyceride (10). Whether or not a similar mechanism operates in humans in endemic fluorosis areas is not known. Whether these changes are responsible for observed small enlargements of the thyroid gland is also not known.

TABLE 1. Age specific prevalence rate of dental fluorosis and goitre

Age group (years)	Percent prevalence	
	Dental fluorosis	Goitre
< 5	1.5	2.6
5 - 12	16.3	16.8
13 - 19	15.4	21.4
20 - 30	15.3	21.2
31 - 40	15.1	16.4
< 40	9.6	6.4
Total	12.2	14.0

TABLE 2. Distribution of blocks according to prevalence of dental fluorosis and goitre

Percent goitre prevalence	Percent prevalence of dental fluorosis			
	< 10	10 - 20	> 20	Total
< 10	1 (100.0)	0	0	1 (100.0)
10 - 20	1 (14.3)	5 (71.4)	1 (14.3)	7 (100.0)
> 20	0	0	2 (100.0)	2 (100.0)
Total	2	5	3	10

(Figures in parentheses show % of administrative blocks with given goitre prevalence)

Controversies about fluoride toxicity on the thyroid gland still remain. But this study confirms the widespread co-existence of fluorosis and goitre, and indicates the need for uniform epidemiological field studies in different part of the country. Such studies should be supported by laboratory investigations into water chemistry, dietary iodine and fluoride estimations, thyroid function and fluoride metabolism, to explore the mode of action of fluoride toxicity on the thyroid gland and its consequences on human health.

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