REVERSAL OF CLINICAL AND DENTAL FLUOROSIS

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ABSTRACT

A large number of Indians are forced to consume fluoride contaminated water. Toxic effects of chronic fluoride ingestion are hitherto considered irreversible. In this study 20 children were selected from an area consuming water containing 4.5 ppm of fluoride (Group A) and a second sample of 20 children from another area consuming water containing 8.5 ppm of fluoride (Group B). All the children were in an age group of 3 to 12 years and weighed 12 to 25 kg. Both samples were graded for clinical, radiological and dental fluorosis. All grades of manifestations were observed .These children were given ascorbic acid (500 mg), calcium (250 mg) and vitamin D_3 (800IU) daily. Follow up revealed reversal of clinical and dental fluorosis after 44 days. Improvement in the Group B sample was slower than Group A. Dosage of ascorbic acid was increased to 750 mg per day, keeping the dosages of other drugs unchanged to Group B children. After 15 days of the revised therapy a marked improvement was noticed in clinical and dental fluorosis in this sample also.

Keywords: *Fluorosis, Ascorbic acid, Calcium, Vitamin D.*

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Fluorosis is an endemic problem in India. Despite determined efforts, a large population still has no alternative but to drink water with high fluoride content. More and more areas are being discovered where people ware ingesting fluoride rich water. There is also a growing concern about effect of fluoride on the fetus especially on the formation of primary teeth. Defluoridation of water, though a simple process, has not been successful in most areas.

Even in areas where defluoridation was adopted a large population had already developed toxic effects considered irreversible. Vitamins C and D, and salts of calcium, magnesium or aluminium were prescribed in an attempt to reverse these effects. The results were, however, inconclusive(l-3). We, therefore, examined the effect of calcium, vitamin D and ascorbic acid supplementation in fluorosis affected children aged 3 to 12 years.

Material and Methods

Twenty children were selected from an area (Shivdaspura) consuming water containing 4.5 ppm of fluorides. This sample was designated Group A. A second sample of 20 children, Group B, was selected from another area (Vanasthali) consuming water having 8.5 ppm of fluorides. All the children belonged to an age group of 3 to 12 years with body weight ranging from 12 to 25 kg. Both the groups were graded for fluorosis. Initial grading was done by the principal author while the post-treatment grading was carried out by the second author. The criteria used are summarized below.

1. ***Clinical Grading(4)***

(i) Mild: Generalized bone and joint pain.

(ii) Moderate: Generalized bone and joint pain, stiffness and rigidity, restricted

movements at spine and joints.

(iii) Severe: symptoms of moderate grading with deformities of spine and limbs, knock knees, crippled or bedridden state.

2. ***Radiological Grading(4)***

(i) Mild: Osteosclerosis only.

(it) Moderate: Osteosclerosis, periosteal bone formation, calcification of interosseous membrane, ligaments, capsules, muscular attachments, tendons.

(iii) Severe: Findings as in moderate with exostoses, osteophytosis and associated metabolic bone disease.

3. ***Dental Fluorosis(5)***

Grade 0: Normal, translucent, smooth and glossy teeth.

Grade I: White opacities, faint yellow line.

Grade II: Changes as in Grade I and brown stains.

Grade III: Brown line, pitting and chipped off edges.

Grade IV: Brown, black and/or loss of teeth.

Investigations included measurement of levels of blood calcium(6) and alkaline phosphatase(7). Fluoride levels were determined in whole blood, serum and urine using fluoride ion-selective electrode(8). Ascorbic acid levels in serum(9) and leucocyte(10) were also measured. All these tests were conducted before starting therapy and at the end of three months of medication.

Children of Groups A and B were treated with 500 mg ascorbic acid in two equally divided doses, 250 mg calcium and 800 IU Vitamin D_3 per day in four equally divided doses. To facilitate compliance number of drugs was minimized by combining vitamin D with calcium in a single drug.

After 44 days, 14 children of Group A and 15 children of Group B were on regular follow up. The pretreatment and post-treatment values of the various indices measured were subjected to a statistical analysis. Apart from computing the mean and standard deviation, the two sets were put to Students 't' test and "Intention to treat analysis" (11) considering the lost cases on follow up which are about 25% of the total studied group and the level of significance determined in terms of 'p' values.

Results

The pretreatment and post-treatment values of biochemical parameters, *viz.,* serum calcium, serum alkaline phosphatase, ascorbic acid (serum and leucocyte) and fluoride j[blood, serum and urine), in both groups are given in *Table I.* Serum calcium (7-8 mg/dl), serum ascorbic acid (0.3-0.7 mg/dl) and leucocyte ascorbic acid levels (18-31 /μg/10^8 WBCs) were low while serum alkaline phosphatase (15-33 KA units/dl), blood fluoride (0.7-1.5 ppm), serum fluoride (1.2-2.2 ppm) and urinary fluoride levels (7-20 ppm) were high in both groups before treatment. Post-treatment levels of these parameters showed significant improvement as indicated in *Table I* ($p<0.001$).

Grading of clinical and dental fluorosis, before and after treatment is shown in *Table II.* Pretreatment gradings of dental fluorosis ranged from Grade I to Grade TV in both samples. Post-treatment examination showed a significant improvement. Most of the children were labelled Grade 0 ($p< 0.001$).

Most of (82.5%) the pretreatment gradings of clinical fluorosis were mild

TABLE I—*Pretreatment and Post-treatment Values of Biochemical Parameters*

Biochemical (parameter)	Group A		p value	Group		p value
	Pretreatment (Mean ± SD)	Post-treatment (Mean ± SD)		Pretreatment (Mean ± SD)	Post-treatment (Mean ± SD)	
Calcium						
Serum (mg/dl)	7.6 ± 0.5	10.5 ± 0.7	<0.001	7.3 ± 0.7	9.1 ± 0.5	<0.001
Alkaline phosphatase						
Serum (KA units/dl)	28.4 ±12.0	17.9 ± 3.8	<0.001	38.8 ±14.5	22.0 ± 4.8	<0.001
Ascorbic acid						
Serum (mg/dl)	0.5 ± 0.1	1.7 ± 0.6	<0.001	0.5 ± 0.2	1.3 ± 0.2	<0.001
Leucocyte ($\mu g/10^8$ WBCs)	25.2 ± 3.0	30.6 ± 4.5	<0.001	25.8 ± 5.4	34.9 ± 5.6	<0.001
Fluoride (ppm)						
Blood	0.9 ± 0.4	0.3 ± 0.1	<0.001	1.1 ± 0.4	0.4 ± 0.1	<0.001
Serum	1.6 ± 0.4	0.3 ± 0.0	<0.001	1.9 ± 0.3	0.3 ± 0.0	<0.001
Urinary	7.3 ± 0.7	5.2 ± 0.5	<0.001	15.4 ± 5.5	7.6 ± 2.9	<0.001

Pretreatment refers to initial evaluation before starting therapy.
Post-treatment refers to evaluation after completion of three months of therapy.

(Grade I). These improved to grade 0 after treatment except in one case. Children with clinical Grades II and III (17.5%) also showed significant improvement ($p<0.001$).

Out of 40 children, 30 were initially screened radiologically. It is a bit too early to evaluate the radiological changes. We propose to report those results at the completion of the study. There was a reversal of clinical ($p< 0.001$) and dental fluorosis ($p< 0.001$) in both groups. However, in Group B (8.5 ppm fluoride in drinking water) the improvement after 44 days was slower in comparison to Group A (4.5 ppm fluoride). This observation was, however, subjective based on clinical examination only. The therapy was then revised for children of Group B. Dose of ascorbic acid was increased to 75b mg per day in three equally divided doses. Dosages of calcium and vitamin D_3 were not changed. Clinical examination after 15 days of the revised therapy showed a marked improvement. No side effects of the medication were observed.

Discussion

Serum calcium levels in these children were low but well above the levels that may produce tetany as observed by Teotia *et at.* (4) also. Expectedly, these levels improved after the therapy. Lower values of serum and leucocyte ascorbic acid were observed in children of both groups. The results are consistent with observations of Jenkins *et al.*(l). Likewise, serum and leucocyte ascorbic acid levels also improved after the supplementation.

TABLE II–*Dental and Clinical Grade of Fluorosis*

Case No.	Group A				Group B			
	Dental Fluorosis(5)		Clinical Fluorosis(4)		Dental Fluorosis		Clinical Fluorosis	
	Pretreat-ment	Post-treat-ment	Pretreat-ment	Post-treat-ment	Pretreat-ment	Post-treat-ment	Pretreat-ment	Post-treat-ment
1	I	0	III	II	II	I	I	0
2	III	0	II	0	II	I	I	0
3	III	0	II	0	III	I	I	0/I
4	II	I	I	0	III	0	I	0
5	I	0/I	I	I	I	0/I	0	0
6	I	0	II	I	III	I	I	0
7	I	0/I	0	0	I	0	I	0
8	I	0	II	I	IV	I	I	0
9	III	I	I	0	I	0	I	0
10	IV	0	0	0	II	0	I	0
11	II	0	I	0/I	III	0	I	0/I
12	I	0	I	0	III	0	I	0
13	II	I	I	0	II	I	0	0
14	III	I	0	0	II	I	I	0
15	III	LC	I	LC	III	I	I	0
16	II	LC	I	LC	III	LC	I	LC
17	I	LC	II	LC	I	LC	0	LC
18	II	LC	I	LC	II	LC	I	LC
19	I	LC	0	LC	III	LC	I	LC
20	II	LC	I	LC	II	LC	I	LC
	$p<0.001$		$p<0.001$		$p<0.001$		$p<0.001$	

Pretreatment refers to initial evaluation before starting therapy
Post-treatment refers to evaluation after completion of three months of therapy.
(Clinical Fluorosis (4); mild - Grade I, moderate - Grade II, severe - Grade III)
LC denotes lost cases.

These children also had a high serum alkaline phosphatase. Others(12,13) had also observed a similar trend. Post-treatment values of serum alkaline phosphatase were nearly normal in both groups ($p<0.001$).

The therapy markedly reduced the fluoride levels in the blood, serum and urine ($p< 0.001$).

Urinary fluoride level has been used to estimate the absorbed amount of fluoride(ll,14). Thus, a reduced fluoride absorption is indicated.

Observations of various workers(3) on therapeutic effect of the ascorbic acid or calcium or vitamin D supplementation in fluorosis were inconclusive. We have not

come across any study where a reversal of fluorosis manifestation was observed by any therapy. In this study we did observe a reversal of dental and clinical fluorosis in children *(Table II)* by calcium, vitamin D_3 and ascorbic acid supplementation well below the toxic dosage.

These findings are of interest since reversal of fluorosis was considered to be irreversible till date. While an isolated study can not be extrapolated, it highlights the need for conducting further studies, especially randomized double blind trials.

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