ABSTRACTS

FLUOROSIS FROM GROUNDWATER IN CENTRAL RAJASTHAN, INDIA

FLUORIDE AND HEALTH HAZARDS: COMMUNITY PERCEPTION IN A FLUOROTIC AREA OF CENTRAL RAJASTHAN (INDIA): AN ARID ENVIRONMENT

India is among 23 nations around the globe where health problems occur due to excess ingestion of fluoride (>1.5 mg/L) in drinking water. In Rajasthan, 18 out of 32 districts are fluorotic, and 11 million of the populations are at risk. An exploratory qualitative survey was conducted to assess the perception in the community regarding fluoride and related health problems in Central Rajasthan. A study on distribution and health hazards by fluoride contamination of groundwater was performed in 1,030 villages of Bhilwara district of Central Rajasthan. One thousand thirty water samples were collected and analyzed for fluoride concentration. Fluoride concentration in these villages varies from 0.2 to 13.0 mg/L. Seven hundred fifty-six (73.4%) of the villages have fluoride concentrations above 1.0 mg/L. Sixty (5.83%) villages have fluoride concentrations above 5.0 mg/L with maximum numbers (24, 19.5%) from Shahpura Tehsil. A detailed fluorosis study was carried out in 41 villages out of 60 villages having fluoride above 5.0 mg/L. In the survey, age, sex, and occupation data were also collected. Four thousand, two hundred fifty-two individuals above 5 years age were examined for the evidence of dental fluorosis, while 1,998 individuals above 21 years of age were examined for evidence of skeletal fluorosis. The overall prevalence of dental and skeletal fluorosis was 3,270/4,252 (76.9%) and 949/1,998 (47.5%), respectively. A maximum of 23.9% (1,016) individuals have mild grade dental fluorosis according to Dean's classification. Three hundred seventy-four (8.8%) individuals have severe type of dental fluorosis. The Dean's Community Fluorosis Index for the studied area in total is 1.62 with a maximum CFI 3.0 in Surajpura of Banera Tehsil. Five hundred sixty-six (28.3%) individuals have Grade I type of skeletal fluorosis while only 12 (0.6%) have Grade III skeletal fluorosis. In conclusion, the prevalence and severity of fluorosis increased with increasing fluoride concentration. It was interesting to note that in some villages, the prevalence and severity of fluorosis were highest in subjects belonging to the economically poor community. Similarly, male laborers had the highest prevalence of fluorosis. The prevalence and severity of fluorosis were higher in subjects using tobacco, betel nuts, and alcoholic drinks. In contrast, subjects using citrus fruits and having good nutritional status showed lowest prevalence.

Authors: Hussain J, Hussain I, Sharma KC.
Correspondence: National River Water Quality Laboratory, Central Water Commission, New Delhi,
110016, India; E-mail: drjakirhussain@gmail.com.
Keywords: Central Rajasthan, India; Dental fluorosis; Skeletal fluorosis.
Source: Environ Monit Assess 2009 Mar 6 [Epub ahead of print, PMID: 19266303].

Soft Tissue Toxicity of Fluoride in Rats

EFFECTS OF FLUORIDE ON THE TISSUE OXIDATIVE STRESS AND APOPTOSIS IN RATS: BIOCHEMICAL ASSAYS SUPPORTED BY IR SPECTROSCOPY DATA

The mechanism underlying the toxicity of fluoride still remains largely unknown. To investigate the effects of different doses of fluoride on blood and tissue oxidative stress and apoptosis, we exposed male rats to three doses of fluoride (10, 50, and 100 ppm in drinking water) for a period of 10 weeks. The results indicated that exposure to 10 ppm fluoride significantly increased the level of reactive oxygen species (ROS) in blood accompanied by a decrease in glutathione (GSH) level. No evidence of oxidative stress was seen in other soft tissues. At 10 ppm, fluoride also decreased the GSH/GSSG ratio but did not produce a more pronounced toxicity in the soft tissues. However, we observed a significantly elevated concentration of ROS and depleted GSH level in blood. Exposure to fluoride did not produce any sign of apoptosis. To support our above-mentioned biochemical observations and to suggest possible mechanisms of the action of fluoride, IR spectra of brain tissues were recorded. The results of these spectra indicated significant shift in the characteristic peak of -OH group in animals exposed to 10 ppm fluoride. At higher doses, however, the shift was minimal. It can thus be concluded that fluoride-induced toxicity is mediated through oxidative stress particularly at a comparatively lower level of exposure, but the higher doses the mode of action still unclear and needs further investigation.

Authors: Chouhan S, Flora S.
Correspondence: Division of Pharmacology and Toxicology, Defence Research and Development Establishment, Jhansi Road, Gwalior 474002, India.
Keywords: Apoptosis; Fluoride toxicity in rats; Glutathione; Oxidative stress; Reactive oxygen species; Soft tissue effects.
Source: Toxicology 2008 Dec 5;254(1-2):61-7.

Role of Impaired Ameloblast Function in Dental Fluorosis

FLUORIDE INDUCES ENDOPLASMIC RETICULUM STRESS AND INHIBITS PROTEIN SYNTHESIS AND SECRETION

BACKGROUND: Exposure to excessive amounts of fluoride (F^-) causes dental fluorosis in susceptible individuals; however, the mechanism of F^--induced toxicity is unclear. Previously, we have shown that a high dose of F^- activates the unfolded protein response (UPR) in ameloblasts that are responsible for dental enamel formation. The UPR is a signaling pathway responsible for either alleviating endoplasmic reticulum (ER) stress or for inducing apoptosis of the stressed cells. OBJECTIVES: In this study we determined if low-dose F^- causes ER stress and activates the UPR, and we also determined whether F^- interferes with the secretion of proteins from the ER. METHODS: We stably transfected the ameloblast-derived LS8 cell line with secreted alkaline phosphatase (SEAP) and determined the activity and localization of SEAP and F^--mediated induction of UPR proteins. Also, incisors from mice given drinking water containing various concentrations of F^- were examined for eucaryotic initiation factor-2, subunit

alpha (eIF2alpha) phosphorylation. RESULTS: We found that F^- decreases the extracellular secretion of SEAP in a linear, dose-dependent manner. We also found a corresponding increase in the intracellular accumulation of SEAP after exposure to F^-. These changes are associated with the induction of UPR proteins such as the molecular chaperone BiP and phosphorylation of the UPR sensor PKR-like ER kinase and its substrate, eIF2alpha. Importantly, F^--induced phosphorylation of eIF2alpha was confirmed *in vivo*. CONCLUSIONS: These data suggest that F^- initiates an ER stress response in ameloblasts that interferes with protein synthesis and secretion. Consequently, ameloblast function during enamel development may be impaired, and this may culminate in dental fluorosis.

Authors: Sharma R, Tsuchiya M, Bartlett JD.
Correspondence: Department of Cytokine Biology, Forsyth Institute, Boston Massachusetts, USA.
Keywords: Ameloblast function; Dental fluorosis; Endoplasmic reticulum stress; Protein synthesis and secretion;
Source: Environ Health Perspect 2008 Sep;116(9):1142-6.

WASTEWATER CONTAMINATION FROM A FERTILIZER PLANT

RADIOACTIVITY AND FLUORIDE CONTAMINATION DERIVED FROM A PHOSPHATE FERTILIZER PLANT IN EGYPT

The environmental pollution caused by the wastewater from a phosphate fertilizer plant in Egypt was investigated. The concentrations of radionuclides and fluoride in phosphate fertilizer (raw materials, end products, and by-products) and other types of fertilizer samples were measured. The concentrations of these elements were also measured in environmental samples (water, sediment, and plants) collected from the proximity of outlets of wastewater discharge pipes of the phosphate fertilizer company. The fluoride concentration ranged from 0.03 to 0.25 mg/g, 0.002 to 0.006 mg/g, 0.42 to 1.88 mg/g, and 0.44 to 7.3 mg/L for phosphate fertilizer, other types of fertilizer, sediment, and water samples, respectively. The activity concentrations of ^{226}Ra ranged from 244 to 1312 Bq/kg, 0.6 to 12.1 Bq/kg, 15.4 to 33.8 Bq/kg, 0.06 to 1.3 Bq/L, and 8.9 to 17.3 Bq/kg for phosphate fertilizer, other types of fertilizer, sediment, water, and plant samples, respectively. The ^{232}Th activity concentrations ranged from 0.7 to 24 Bq/kg, 0.7 to 14.5 Bq/kg, 10.4 to 19.3 Bq/kg, 0.02 to 0.16 Bq/L, and 2.0 to29.8 Bq/kg for these samples, respectively. Also, the ^{40}K activity concentrations ranged from 2.1 to 1.4 Bq/kg, 2.1 to 5313 Bq/kg, 128 to 281 Bq/kg, 0.14 to 0.6 Bq/L, and 686 to 977 Bq/kg for these samples, respectively. Low content of ^{137}Cs was determined in only two phosphate fertilizer samples (F2 and F3; mean 1.3 Bq/kg) and inmost of sediment samples (with a range of 1.0 to 2.4 Bq/kg). The radium equivalent, as a radiation hazard index, ranged from 284 to 1316, 9.6 to 432, and 47 to 70 Bq/kg for phosphate fertilizer, other types of fertilizer, and sediment samples, respectively. These results indicate that the wastewater polluted with fluoride produced from the phosphate fertilizer company may be affecting the environment. The radioactivity content measurements indicate that the environment may be slightly affected with low concentrations of ^{226}Ra and ^{232}Th

isotopes due to the discharged wastewater from the phosphate fertilizer industry. In addition, results of comparison studies for radioactivity concentrations are also presented and discussed.

Authors: Mourad NM, Sharshar T, Elnimr T, Mousa MA.
Correspondence: MA.Chemistry Department, Faculty of Science, Banha University, Banha, Egypt.
Keywords: Fluoride; Environmental pollution; Phosphate fertilizer; Radioactivity; Wastewater.
Source: Appl Radiat Isot 2009;Feb 20 [Epub ahead of print, PMID: 19282198].

PERFLUOROOCTANE SULFONATE ENVIRONMENTAL INVENTORY

A FIRST GLOBAL PRODUCTION, EMISSION, AND ENVIRONMENTAL INVENTORYFOR PERFLUOROOCTANE SULFONATE

This study makes a new estimate of the global historical production for perfluorooctane sulfonyl fluoride (POSF), and then focuses on producing a first estimate of the global historical environmental releases of perfluorooctane sulfonate (PFOS). The total historical worldwide production of POSF was estimated to be 96,000 t (or 122,500 t, including unusable wastes) between 1970 and 2002, with an estimated global release of 45,250 t to air and to water between 1970 and 2012 from direct (manufacture, use, and consumer products) and indirect (PFOS precursors and/or impurities) sources. Estimates indicate that direct emissions from POSF-derived products are the major source to the environment resulting in releases of 450 to 2700 t PFOS into wastewater streams, primarily through losses from stain repellent treated carpets, waterproof apparel, and aqueous fire fighting foams. Large uncertainties surround indirect sources and have not yet been estimated for perfluorooctane due to limited information on environmental degradation, although it can be assumed that some POSF-derived chemicals will degrade to PFOS over time. The properties of PFOS (high water solubility, negligible vapor pressure, and limited sorption to particles) imply it will reside in surface waters, predominantly in oceans. Measured oceanic data suggests approximately 235 to 1770 t of PFOS currently reside in ocean surface waters, similar to the estimated PFOS releases. Environmental monitoring from the 1970s onward shows strong upward trends in biota, in broad agreement with the estimates of use and emissions made here. Since cessation of POSF production by 3M in 2002, a reduction in some compartments has been observed, although current and future exposure is dependent on emission routes, subsequent transport, and degradation.

Authors: Paul AG, Jones KC, Sweetman AJ.
Correspondence; Centre for Chemicals Management, Lancaster Environment Centre, Lancaster University, Lancaster, UK.
Keywords: PFOS: perfluorooctane sulfonate; POFS: perfluorooctane sulfonyl fluoride; PFOS/POFS in the environment.
Source: UK Environ Sci Technol 2009 Jan 15;43(2):386-92.

Central Mechanism of Autism Spectrum Disorder: Part 3

THE ROLE OF EXCITOTOXIN FOOD ADDITIVES AND THE SYNERGISTIC EFFECTS OF OTHER ENVIRONMENTAL TOXINS

There is compelling evidence from a multitude of studies of various design indicating that food-borne excitotoxin additives can elevate blood and brain glutamate to levels known to cause neurodegeneration and in the developing brain, abnormal connectivity. Excitotoxins are also secreted by microglial activation when they are in an activated state. Recent studies, discussed in part 1 of this article, indicate that chronic microglial activation is common in the autistic brain. The interaction between excitotoxins, free radicals, lipid peroxidation products, inflammatory cytokines, and disruption of neuronal calcium homeostasis can result in brain changes suggestive of the pathological findings in cases of autism spectrum disorders. In addition, a number of environmental neurotoxins, such as fluoride, lead, cadmium, and aluminum, can result in these pathological and biochemical changes.

Author: Blaylock RL.
Correspondence: Belhaven College, Jackson, Mississippi, USA. E-mail: blay6307@bellsouth.net.
Keywords: Aluminum; Cadmium; Calcium homeostasis; Fluoride and the brain; Food-borne excitotoxin additives; Lead; Lipid peroxidation products; Microglial activation; Neurodegeneration.
Source: USA Altern Ther Health Med 2009 Mar-Apr;15(2):56-60.

Amelioration of Fluoride Toxicity on Reproductive Organs of Female Rats

AMELIORATION OF FLUORIDE TOXICITY BY VITAMINS AND CALCIUM ON REPRODUCTIVE ORGANS OF FEMALE RAT

Normal Wistar strain female rats (*Rattus norvegicus*) weighing between 150 and 200 g were given drinking water containing 5.8 ppm fluoride ion and administered vitamin C (6 mg), and vitamin C (6 mg) + D (6 mg once a week) + calcium (6 mg) for 30 days. F water produced a reduction in the weights of ovaries, uterus, vagina, kidneys, and adrenal glands, circulating levels of estrogen, number of litters, fertility rate, and altered tissue and serum biochemistry compared to control rats. The concentration of cholesterol in the ovaries and adrenals, however, increased significantly. The above altered parameters were restored partially/completely after exogenous feeding with vitamin C and vitamins C + D and calcium. The data suggest that fluoride induced adverse effects on reproductive and other organs in female rats, whereas administration of vitamin C, vitamin D, and calcium ameliorated the fluoride toxicity. Therefore, vitamins C and D and calcium play an important role in prophylactic treatment of fluorosis.

Authors: Sharma JD, Solanki M, Solanki D.
Correspondence: Department of Zoology, Reproductive Physiology and Environment Toxicology Laboratory University of Rajasthan, Jaipur India; E-mail: jashree_ajay@yahoo.co.in.
Keywords: Calcium; Estrogen; Female Wistar strain rats; Fluoride toxicity; Reproductive organs; Vitamins C and D.
Source: Toxicol Environl Chem 2008;90(4):755-63.

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OSTEOSARCOMA CASE STUDY

SERUM FLUORIDE AND SIALIC ACID LEVELS IN OSTEOSARCOMA

Osteosarcoma is a rare malignant bone tumor disease presenting painful swelling that occurs most commonly in children and young adults. Various proposed etiological factors for osteosarcoma are ionizing radiation, family history of bone disorders and cancer, chemicals (fluoride, beryllium, and vinyl chloride), and viruses. The status of fluoride levels in serum of osteosarcoma is still not clear, although recent reports indicate there may be a link between fluoride exposure and osteosarcoma. Glycoproteins and glycosaminoglycans are an integral part of bone, and prolonged exposure to fluoride for long duration has been shown to cause degradation of collagen and ground substance in bones. The present study was planned to analyze serum fluoride, sialic acid, calcium, phosphorus, and alkaline phosphatase levels in 25 osteosarcoma patients and to compare them with those of two 25 age- and sex-matched groups of patients: (1) a group with bone-forming tumors other than osteosarcoma and (2) a control group with musculo-skeletal pain. Fluoride levels were analyzed by the ion selective F electrode, and sialic acid was analyzed by Warren's method. The mean serum fluoride concentration was significantly higher in patients with osteosarcoma compared with the other two groups. The mean value of serum fluoride in patients with other bone forming tumors was approximately 50% of the osteosarcoma group; however, it was significantly higher than in the musculo-skeletal-pain control group. Compared to the control group, serum sialic acid concentration was also significantly higher in patients with osteosarcoma as well as in the group with other bone-forming tumors. There was, however, no significant difference in sialic acid levels in the patients with osteosarcoma and those with other types of bone-forming tumors. These results showing a higher serum fluoride level in osteosarcoma patients than in the two other groups suggest a role of fluoride in the etiology of osteosarcoma.

Authors: Sandhu R, Lal H, Kharb S.
Correspondence: Department of Biochemistry, Pt B D Sharma University of Health Sciences, H No 1447, sector-1, Urban Estate, Rohtak 124001, Haryana, India.
e-mail: simmikh@rediffmail.com
Keywords: Alkaline phosphatase; Osteosarcoma; Sialic acid; Serum fluoride
Source: Biol Trace Elem Res 2009;24 April.[Epub ahead of print 2009, DOI 10.1007/s12011-009-8382-1].

CORRECTION

CHANGES IN MINERAL COMPOSITION OF HUMAN PRIMARY DENTITION by Grzegorz Pawlus, Izabela Gutowska and Zygmunt Machoy, Fluoride 2009; 42(1):23-8.

Although the caption for Figure 1 is correct in giving the age of the tooth buds of human fetuses as 18 to 32 weeks, the figure itself incorrectly gives the age of the foetuses in months rather than weeks.
