FLUORIDE

February 2012

Introduction

Fluoridation of drinking water was first carried out in the city of Grand Rapids, Dakota, U.S.A. in 1945. Water fluoridation in the U.K. began in the mid 1950's [1] and has since been carried out on a limited, regional basis. Currently about 10% of the supply, mainly in the Midlands and the Northeast of England, is fluoridated, with the mean fluoride content of water being maintained between 0.9 and 1.1 ppm (mg/L). The World Health Organization has also suggested that drinking water should be adjusted to a concentration of between 0.5 and 1.0 ppm (mg/L), depending on the climate, on account of the alleged dental health benefits of moderate fluoride ingestion [2]. Fluoridation of water is proposed as a safe and inexpensive way to prevent tooth decay, regardless of socio-economic status or access to dental care, but the current U.S. guidelines are that the maximum permitted level of fluoride in drinking water should be lowered to 0.7 ppm (mg/L) [3] to limit the risk of inducing fluorosis due to unknown, and possibly excessive, exposure to fluoride from multiple combined sources. However, the practice of adding any fluoride at all to municipal water supplies has many opponents.

Biological effects of fluoride ingestion

Fluoride is the reduced form of fluorine, which has no known biological essentiality in man. It can occur as fluoroacetate, the fluorinated calcium phosphate common in bedrock silicates. Depending on the rock's mineral content as on well as the water temperature, rainwater filtering through these strata can dissolve fluoroacetate and result in unsafe levels of naturally occurring fluoride in aquifers used for drinking water supplies [4]. However, the majority of ground water reserves do not contain high levels of naturally occurring fluoride.

Ingested fluoride is sequestered into bone as well as teeth [5] and the long-term effects on bone of low-level exposure to fluoride are unknown. A study in Finland that examined hip fractures in elderly women who drank well water with high concentrations of fluoride found that higher fluoride levels were associated with increased risk for hip fractures in women aged 50-64 years [6]. The condition of skeletal fluorosis, characterized by joint pain, dense bone and limited joint movement, has been reported as occurring in individuals drinking water with a fluoride content some thirty times the level recommended for fluoridation; this condition is more common in subjects suffering from nutritional deficiencies. A WHO working group concluded that skeletal fluorosis and an increased risk of bone fractures occur at a total intake of 14 mg fluoride per day, with evidence suggestive of an increased risk of bone effects at intakes above about 6 mg fluoride per day [7].

With drinking water fluoride levels above 5 ppm, fluoride can also cause the development of brittle bone disease. Some studies have also found a higher risk of simple bone fractures in older men and women drinking water with fluoride levels around 1.0 ppm, the level recommended for fluoridation [8]. Despite forceful argument to the contrary, the case for water fluoridation is by no means clear [9] and fluoride ingestion at these low levels has been blamed for a variety of conditions, including many types of cancer (e.g. bladder cancer) [10] and impaired intelligence in children [11]. In addition, mild fluorosis (hypomineralization of the dental enamel) is found in more than one quarter of US children [12]. In communities with high natural fluoride levels in drinking water, the prevalence of dental fluorosis is directly related to the level of fluoride in the water source [13].

Indications

Fluoride in urine should be measured in subjects with unexplained bone disease, including a tendency to fracture. It may also be of importance in a range of other conditions, including abnormalities of thyroid function. Dental fluorosis in children may be caused by excessive fluoride ingestion. Fluoride in drinking water should be measured to help identify the potential source of excessive fluoride ingestion.

Patient preparation: No special patient preparation is required.

Specimen requirements: Urine - although a 24-hour collection is more representative, measurements on early morning, second void urine samples can also be used to assess fluoride excretion.

Water – a representative (500 mL) water sample should be collected. If taken from a tap, the water should be free of debris and the sample should be from water that has been in the pipework for a number of hours (e.g. the first run of the tap during the day). Collect the specimen in a plastic container; do not use a glass vessel.

Methodology: Fluoride is measured by ion-specific electrode.

Interpretation: Water samples from non-fluoridated areas should have a fluoride content of less than 0.3 mg/L (ppm).

References

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