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Prenatal Fluoride - Necessity Or A Myth

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Abstract
There are many views regarding the passage of Fluoride across the placenta. Some authors suggest placenta as a complete barrier to Fluoride and some say that it is a partial barrier. The fact that primary dentition has less severe degree of Fluorosis than permanent dentition, may indicate the presence of placental barrier but the similar fluoride concentration in cord blood and maternal blood in mothers receiving fluoridated water also shows placenta as a partial barrier.

Key Words
Fluoride, placental barrier, primary dentition, F supplements

Introduction

The forerunner to the finding that fluorine and dental caries are related was discovered by Eager, in 1901, of a dental condition characterized by white flecks and brown stains in person living in Naples, Itlay. Mckay of Colorado springs, USA, made a similar independent observation and called the stain mottled enamel.[1] Mottling of tooth enamel now known as Dental fluorosisis characterized by white spots or flecks in mild form to brown or dark stained, pitted in severe form. Mottling of the enamelis a developmental disturbance of dental enamel caused by the consumption of excess fluoride during tooth development.[2] A tooth is no longer at risk of fluorosis after eruption into the oral cavity. Fluoride has both systemic and topical actions that are of importance in dental health. Systemically, fluoride acts on teeth prior to their eruption by being built into the crystal structure of the enamel and making it resistant to decay. The mineralization of primary teeth begins in utero, and this has led to the suggestion that fluoride supplements to be given in pregnancy. However there is little evidence of the effectiveness of fluoride supplementation in pregnancy.[3], [4]

Fluoride Transfer Through Placenta

The placenta is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, waste elimination, and gas exchange via the mother's blood supply, fight against internal infection and produce hormones to support pregnancy. The placental tissue is permeable to high molecular weight compounds such as gamma globulins, but generally an inverse relation exists between the molecular weight of compound and their ability to pass through placenta (Villey, 1960)[5]. The presence of Fluoride in primary teeth that develop during the intrauterine phase and the rapid increase in Fluoride level of fetal blood when medications containing F are administered to pregnant women indicate that Fluorides' rapidly cross the placenta. The skeletal F also increases with fetal age in areas where water supplies has 0.1,0.5 ppm of Fluoride (Gedalia, 1970)[6], thus indicating that placental tissue does not selectively inhibit the transfer of F to the fetus, although at higher levels of F ingestion , a partial barrier to F transfer may exist. Armstrong et al[7] suggested that there is no placental F barrier sufficient to maintain disequilibrium of Fluoride concentration in maternal and fetal circulations under normal physiologic condition. Consequently, Fluoride may be expected to pass through the placenta in physiological concentrations into the fetal circulation and subsequently incorporated into developing teeth and bones. The F concentration was found around 0.68 and 0.88 micro M in cord and maternal blood using specific F electrodes in 16 mothers receiving potable water containing low levels of F. High correlation between cord and maternal blood indicates passive diffusion of F across the placenta (Shen and Taves, 1974).[8] Fetal blood levels of fluorides in mothers who had taken sodium fluoride was statistically higher than in the controlled group (2.6 mumol/l and less than 1 mumol/l); this demonstrates in a statistically significant way that fluoride passes across the placenta in the fifth and sixth months of pregnancy which is the time when the milk teeth start to develop in the uterus.[9] Another study was conducted on 25 healthy women residing in optimum fluoride areas, who were to deliver normally through vaginal route, to correlate the maternal and cord plasma fluoride levels and evaluate the placental transfer of fluoride. A wide variation was found in the maternal and cord plasma fluoride levels. The difference between cord fluoride and maternal fluoride suggest that placenta acts as a partial filter for F. A possible explanation of F loss during transmission from maternal to fetal has been presented by Chlubek et al[10] which suggests that F can be accumulated in marginal parts of the placenta as a result of higher concentrations of calcium in those areas. According to Caldera et al[11], Maternal F and cord F levels depends on intake and movement of F. They propose the concept of maternal fetal amniotic pool that regulates maternal and fetal plasma levels according to F intake. Moreover, haemodynamic and haematochemical variations at the time of delivery also appear to affect cord F levels as suggested by Brambilla et al.[12] Higher maternal age can be related to low blood flow at

placental bed. In only 8 percent of the cases the fluoride levels in cord plasma were higher than maternal plasma. It was deduced that the placenta allows passive diffusion of fluoride from mother to fetus and does not act as a barrier.[13] A recent study[14] supports the view that the placenta has a protective role on fetus by preventing transfer of excess F to the growing fetus and the capacity of placenta as F filter is still a point of debate. When the drinking water and food has high F concentration, the F content of the placenta is significantly higher than that of the mother serum, while the cord blood has the least. Thus, these findings indicate that the placenta represents a natural barrier to the passage of larger quantities of F to the fetus probably by binding to calcium ions in the placenta.

J Opydo-Szymaczek, M Borysewicz-Lewicka[15] evaluated placental transfer of fluoride (F) in 30 pregnant women at the time of giving birth, who were living in Poznan, Poland, where the F concentration in the drinking water ranges from 0.4 to 0.8 mg/L. The mean concentration of F in maternal plasma was significantly higher than in venous cord plasma (3.54 vs. 2.89 µmol/L, respectively), and both values were similar to those previously documented in pregnant women taking prenatal F supplements. These results confirmed that Fluoride readily passes through the placenta.

Mechanism Of Action

The placenta may have a regulatory function in preventing excess Fluoride in maternal blood from reaching the fetal circulation – a hypothesis described by Gedalia et al[16] and Ericson and Wei[17]. This may explain why there is less enamel fluorosis in primary teeth of children who live in communities with even 8-10 ppm F concentration. Fluoride passes from the mother to fetal teeth. Much of the fluoride is taken up in secretary enamel, probably by the forming mineral apatite crystals. Some is retained with residual proteins. The low concentration of fluoride in the inner enamel is incorporated mainly during the secretary stage, while the enhanced concentration in the surface enamel is produced during the much longer maturation stage. Mature, hard enamel is generally absent during fetal life.

Another important factor in considering prenatal supplementation is related to the amount of tooth mineralization that occurs prenatally. Although calcification of most of the primary teeth (except the incisors) begins in utero, most of the caries susceptible surfaces calcify after birth. Thus F acquired during pregnancy has an insignificant effect on caries in primary teeth.

The American Dental Association (ADA) endorses the daily use of fluoride supplements (as drops, tablets or lozenges) by children 16 years old or younger.[18] While the ADA and the American Academy of Pediatric Dentistry revised the supplementation schedule in 1994 in response to concerns about the increase in the prevalence of Fluorosis.[19] The Canadian Dental Association recommends supplements only for children who have had high caries experience and whose total intake of fluoride is below 0.05 to 0.07 milligrams of fluoride per kilogram of body weight.[20] A group of European experts recommended in 1991 that "fluoride supplements have no application as a public health measure" and that "a dose of 0.5 mg/day fluoride should be prescribed for at-risk individuals from the age of 3 years."[21] In 2006, the Australian Research Centre for Population Oral Health's workshop on the use of fluorides in caries prevention concluded that "fluoride supplements in the form of drops or tablets to be chewed and/or swallowed should not be used."[22]

The Prenatal F Supplementation

Systemic fluoride dosage to prevent caries appearsto be 0.05 to 0.07 mg/kg/d.[23] The narrownessof the therapeutic range is emphasized by the factthat mild fluorosis has been seen with oral intakesgreater than 0.1 mg/kg/d.[24] Thus, it is important toexamine carefully the data on the age at which fluoride supplementation is started and its relationship to caries prevention. The critical period during which the fluoride must be ingested systemically in order to exert maximum cariostatic effects is during the mineralization of the surface of crown. For primary teeth, this process is mostly post natal except for the anterior incisors. For maximum benefit, the ingestion of F supplements should be started shortly after birth and continued until the age of about 12 depending on the fluoridated areas.

The use of prenatal F was based on the water F studies done by Arnolda et al,[25] Blayney[26] and Tank and Storvick,[27] who suggested that the use of F water during prenatal years and continuing with post natal use increased the protection of primary teeth over that provided by only post natal exposure. The findings were discarded by many other workers. Glenn[28], [29] in her study claimed that the teeth of the children whose mother had received prenatal F supplements were denser white with shallower occlusal grooves and had no pitting. The difference of 93% DFS was seen in the children of mothers who had NaF tablets in pregnancy and in control group. She also suggested that enamel surface of prenatally protected teeth remains caries free in acidic environment. The results of Glenns studies are remarkable but the study was not a carefully controlled, double blind one. In 1966 U.S Food and Drug administration banned the advertising and marketing of drug manufacturers of Fluoride products that claimed caries preventive benefits when ingested as prenatal supplements.

Conclusion

There is no doubt that F passes through the placenta because it is found in fetal blood and calcified tissues. Consequently F may be expected to pass through the placenta in physiologic concentration into fetal circulation and subsequently incorporated into developing teeth and bone. However, placenta may have a regulatory function in preventing excessive F in maternal blood from reaching the fetal circulation.

Another important factor in considering the prenatal F supplementation is related to the amount of tooth mineralization that occurs prenatally. Although, calcification of primary teeth (except incisors) begins in utero, most of the caries susceptible surfaces of teeth calcify after birth. Therefor, as long as F ingestion is initiated shortly after birth, it is probably sufficient.

Results of studies by Leverrett et al 2005[30] and Fontele et al 2006[31] don't support the hypothesis that F supplements by pregnant women benefit their offspring. Moreover, modern research provides little support for recommendation of both prenatal and postnatal fluoride supplements.

According to data collected, the area where drinking water fluoride conc. ranges from 0.4 to 0.8mg/l, fluoride levels in mother plasma and cord plasma are comparable to those documented in

patients from other areas who are taking fluoride supplements (1.5mg/day). Thus, the additional fluoride supplements should not be encouraged or indicated in these populations. This practice could result in further increase in fluoride exposure to the fetus, which raises concerns in view of the potential negative effects of excessive amounts of fluoride on fetal development.

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