

Research into the Distribution of Fluoride in Fetal Tissue

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Abstract : The study contains the results of fluoride testing done on 31 fetal specimens. It demonstrates that fluoride can pass through the placenta into the fetus, that bone tissues shows the highest levels of fluoride while brain tissue shows the lowest, and that overall level of fluoride increases with the fluoride burden of the mother and the age of the fetus.

Key Words: Fluoride, Calcium fluoride, Fluorapatite

With regards to distribution of fluoride within organisms, a relatively large number of experimental studies have been done on adults and animals^[1,2], whereas there are relatively few reports on the question of whether fluoride can pass through the placenta to reach the fetus and how fluoride is distributed between the different types of tissue. The present research involved the determination of fluoride levels of various types of fetal tissue taken from aborted fetuses whose mothers had differing levels of fluoride intake. The full report is as follows:

Materials and Methods

1. Source of fetal specimens: 21 specimens were drawn from Xiaochang township of Pengshui county. Rural residents of that region use high fluoride coal (with a fluoride content between 180-1850 mg/kg, averaging 653.47) for heating and to cook corn, leading to fluoride contamination of the air and food supply (the average level of indoor airborne fluoride was found to be 0.134 mg/m³; the fluoride content of the corn ranged between 18.5 and 88.5 mg/kg, with an average of 46.17 mg/kg). Corn is the year-round staple food of the rural inhabitants of the region. The other 10 specimens were drawn from urban residents of Chengdu, whose tap water showed only trace amounts (<1 ppm) of fluoride.

2. Determination of tissue fluoride: Fresh 40 g tissue samples were taken from the heart, liver, lungs, kidneys, brain, muscles, skull, femur, cartilage, and thymus of each fetus. Absorbent paper was used to soak up surface moisture, and the tissue was placed in a 600°C box furnace for two hours. Following incineration, a UJ-25 DC potentiometer and a PHS-2 PH meter were used in tandem to determine fluoride content. A control sample was also tested to rule out possible interference from fluoride already present in the box furnace.

Results

1. Fluoride levels of the various tissues: See table 1 for a comparison of fluoride in various tissues among fetuses whose mothers had differing fluoride intake.

Table 1: Comparison of fluoride in tissues among fetuses whose mothers had differing fluoride intake (ppm)

Group	n	Thymus	Heart	Liver	Lung	Kidney	Brain	Muscle	Skull	Femur	Cartilag
High Intake	21	51.57	50.67	45.53	43.04	39.94	31.70	53.44	338.99	110.52	47.24
Low Intake	10	48.08	47.38	43.36	40.09	40.00	23.24	41.11	109.16	60.54	41.90
P							<0.05	<0.05	<0.01	<0.05	<0.05

From table 1 it is clear that, excluding certain individual organs, the fetuses whose mothers had high fluoride intake generally had higher fluoride levels than the fetuses whose mothers had low fluoride intake, particularly in the skull, femur, and brain tissue. The difference between the two groups is statistically significant.

2. See table 2 for a comparison of fluoride tissue level among fetuses grouped by age.

Table 2: Tissue fluoride of fetuses by age

Age (month)	n	Thymus	Heart	Liver	Lung	Kidney	Brain	Muscle	Skull	Femur	Cartilag
4-5	9	46.03	52.04	45.75	44.31	39.55	31.43	47.10	318.23	90.16	39.90
6-8	12	45.27	49.74	45.36	42.08	40.02	31.84	59.74	354.50	125.71	52.75
P								<0.05	<0.05	<0.01	<0.05

From table 2 it is clear that the fluoride in muscle, skull, femur, and cartilage tissue increases with the age of the fetus. The other types of tissue showed no significant difference, however.

3. Fluoride content of various types of fetal tissue: the ordering of fluoride content from the various types of tissue from highest to lowest was skull > femur > thymus > heart > muscle > cartilage > liver > lung > kidney > brain. Their respective average fluoride levels (ppm) are 264.84, 94.40, 50.44, 49.61, 49.46, 45.52, 44.83, 42.09, 39.96, and 28.97. A variance analysis revealed a significant difference when the skull and the femur levels are compared with the other tissues ($P < 0.05-0.01$), a significant difference between the skull and the femur ($P < 0.01$), and a significant difference between the brain and the other tissues ($P < 0.05-0.01$). There are no other significant differences between any other types of tissue.

Discussion

No matter by what means fluoride enters the body, about 75% is found in the plasma following absorption, with the remaining 25% entering the red blood cells to be carried by circulation throughout the body and distributed into various organs. 90-99% of the body's fluoride is eventually deposited in the skeleton; it is already universally recognized among researchers that fluoride has a special affinity for bone tissue.

This study took 31 pregnant women with differing levels of fluoride intake and

determined that fluoride levels in tissues from the aborted fetuses showed dispersal consistent with what was seen in adults^[3]. Besides the primary distribution in bone tissue, there was fluoride found in various other organs throughout the body, and the fluoride levels increased with the fluoride intake of the mother, indicating that fluoride can pass through the placenta and into the fetus. Therefore taking suitable measures to control fluoride intake during pregnancy is essential.

The level of fluoride in the fetal bone tissue increases with the age of the fetus, showing a significant difference; this is basically consistent with experiments involving adults^[4]. Excluding muscle, soft tissues do not show a marked increase with age, suggesting that the fluoride build-up in fetal tissue is primarily a skeletal phenomenon. The ordering of fluoride levels in tissue from highest to lowest was skull > femur > thymus > heart > muscle > cartilage > liver > lung > kidney > brain, with both skull and femur showing significant difference as compared to the other tissues. The skeleton is primarily hard bone, so this result is related to the formation of fluorapatite. Could the higher fluoride levels in the skull be due to the fact that the skull is calcified earlier in fetal development than the femur^[5]? The amount of fluoride in brain tissue is relatively low; this is attributable to the presence of the blood-brain barrier. Also, the levels in the kidneys are comparatively low; in the average adult, fluoride is expelled through the kidneys, and so the fluoride content of kidney tissue is fairly high, however this study found that all 31 fetal specimens show low kidney fluoride, whether or not this has something to do with the decreased level of kidney function at that stage of development is a topic for further study.

Fluoride entering the body during the fetal stage of development is distributed to tissues throughout the body, indicating that fluoride, though bone-focused, is a complete-body poison. At what concentration fluoride causes physiological or pathological effects in the various organ tissues in which it is found is still unclear; this is another topic awaiting further research.

References

1. SM Mohamedally 1984, Studies of the Relative Fluoride Content of Normal and Pathologically Mineralized Human Tissues. *Fluoride* 17(4): 246-251.
2. Dominok G, et al. 1984. Fluoride Content of Bones of Retired Fluoride Workers. *Fluoride* 17(1):23-26
3. Shanggong Cunliang, translator 1980. Fluoride's effect on collagen. *Foreign Medical Sciences (Section of Medgeography)*, 1(4):185
4. Luo Dengyu 1979. *Medical Reference (1)*: 86, Baotou Medical Institute
5. X-ray Diagnostics Writing Team of Shanghai No.1 Medical College 1982. *X-Ray Diagnostics*. Shanghai Science and Technology Publishers, First Edition, 412.