Mercury Levels in Human Maternal and Neonatal Blood, Hair and Milk

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INDRODUCTION

There are many reports on the mercury levels in the blood and hair samples obtained from mother and baby (HOSHINO et al, 1966, SUZUKI et al, 1971, DAL CORTIVO, 1964). But, in the most cases, the mercury levels were determined independently in mother's samples and in the baby's samples and the information on the relationship between mercury levels of mother and those of her baby was scarecely obtained. It has been assumed generally on epidemiological and experimental evidence that methylmercury level in blood can serve as an index of that in the brain under certain condition (BERLIN et al, 1975). However, in order to estimate the mercury levels in foetus from mother, it is essential to find an accessible index that reflects the concentration of mercury in the foetus. This work was undertaken to clarify whether the mercury level in the blood or hair of mother can serve as an index of mercury level in the foetus.

MATERIALS AND METHODS

Blood and hair of mother-neonate pairs and mother's breast milk were sampled at Sumida Obstetric Hospital and Oshima Clinic of Toho University, Tokyo, at the time of delivery during the period from July to November 1974. Hair samples were washed with 0.2 % neutral detergent (Alco-L) solution, distilled water and acetone successively and were air-dried for the analysis of total mercury. Blood and breast milk samples were taken in polyethylene container and stored at -20°C in refrigerator until the time of analysis. For analysis of total mercury, some ten mg of hair or about 200 mg of blood samples weighed in a quartz boat, covered with 0.5 g of calcium hydroxide as neutralizing agent and put in a quartz furnace of Sugiyamagen MV-250 mercury vapor generator. The samples were burned in an oxygen stream at 850°C for 8 min and the evolved mercury was trapped on a gold trap. Immediately after the termination of the combustion, the gold trap was heated and the released mercury was measured by the flameless atomic absorption spectrometer, Shimazu UV-201. On the other hand, 20 ml of breast milk was dige-

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sted with nitric and sulfuric acid, and the mercury was determined by the method of reductive aeration with stannous chloride followed flameless atomic absorption spectrometry.

RESULTS

The data were summarized in Table I. As shown in

TABLE I

Total mercury levels in breast milk, hair, blood of maternal and neonatal pairs.

Sample No.	Mother age	Breast milk (ppb)	Hairs (ppm)		Blood (ppb)	
			Maternal	Neonatal	Maternal	Neonatal
1	24	0.5	2.7	-	25	29
2	30	6.0	4.9	3.8	33	26
3	23	2.0	3.5	7.9	-	17
4	26	3.1	2.8	3.9	48	25
5	25	9.8	5.8	5.7	23	32
6	25	0.4	7.3	6.3	25	50
7	22	4.5	5.0	4.3	40	23
8	21	5.0	3.4	7.3	25	41
9	33	3.3	3.5	7.0	43	36
10	31	3.1	3.4	5.8	19	28
11	31	3.1	3.4	5.8	54	18
12	24	3.5	1.7	4.1	12	21
13	25	-	1.8	2.7	23	16
14	35	3.2	3.4	3.8	18	19
15	25	3.3	1.2	2.9	14	19
16	26	2.1	1.5	5.0	16	28
17	31	3.1	2.0	5.3	39	(71)
18	24	1.4	3.2	3.4	14	26
19	29	-	6.7	5.2	22	(96)
20	23	3.6	2.8	3.4	18	18
21	24	2.8	2.3	4.2	14	47
22	30	8.0	2.9	3.2	32	14
23	23	5.4	2.6	3.9	10	20
24	25	1.7	2.4	3.2	21	16
25	26	4.0	2.0	2.0	19	15
26	25	-	1.8	4.6	16	34
27	26	1.8	2.5	4.2	28	23
28	22	-	3.9	3.5	-	33
29	23	1.8	6.1	3.5	-	-
30	25	4.2	3.5	4.4	-	-
31	26	1.1	2.2	2.9	-	-
32	20	5.0	3.3	2.0	7	12
33	26	3.5	2.6	(10.8)	30	48
34	25	3.7	-	3.6	-	-
Mean	25.9	3.6	3.3	4.3	25	26
S.D.	3.5	2.2	1.5	1.5	12	11

The values in parentheses were omitted by the statistical method of GRUBBS (1974) ($p < 0.005$).

the table, the mean total mercury level in breast milk was 3.6 ± 2.2 ppb. The levels in blood were higher than that of milk, 25 ± 12 ppb for mother and 26 ± 11 ppb for neonate. Although the mean level in blood of neonate was almost same as that of mother, the mean total mercury level of hair in neonate was about 1.3 times that in mother, that is, the levels were 3.3 ± 1.5 ppm for mother and 4.3 ± 1.5 ppm for neonate.

Table II shows the correlation coefficients between total mercury concentrations in each two of these items. Significant correlation was observed between neonatal hair and maternal blood, or between neonatal hair and neonatal blood. However, no correlation between the two of the other items was found.

TABLE II

Correlation coefficients between total mercury concentration in breast milk, hair and blood of maternal and neonatal pairs.

		B M	M H	N H	M B
Breast milk	(BM)	1	-	-	-
Maternal hair	(MH)	0.164 (30)	1	-	-
Neonatal hair	(NH)	0.027 (28)	0.314 (31)	1	-
Maternal blood	(MB)	0.214 (25)	0.242 (28)	0.404* (26)	1
Neonatal blood	(NB)	0.222 (26)	0.334 (28)	0.529* (26)	0.120 (27)

*) statistically significant ($p < 0.05$)
The number of paired sample is given in parentheses.

DISCUSSION

There are few reports on the total mercury level in breast milk. Swedish was reported to contain total mercury of 0.8-1.6 ppb (PITKIN, 1976) and 0.93 ppb (WESTOO, 1973) in their breast milk. On the other hand, in Japan the mean total mercury level in milk of healthy mothers in the Minamata area was reported to be relatively high, 63 ppb (HARADA, 1968). The higher level, 0.50-0.54 ppm was reported of samples obtained at agricultural district (WAKATSUKI, 1973). These levels were considerably higher than those reported of Swedish and probably due to taking samples from the women contaminated with industrial pollution or agricultural chemicals, respectively. While, the mean total mercury level obtained in the present study was 3.6 ± 2.2 ppb as shown in Table I and this value is slightly higher than the Swedish level but remarkably lower than those described earlier. It seemed that this value indicated the background levels of breast milk of Japanese. The major reason for the difference between mercury level of Swedish and that of Japanese probably results from varying degree of methylmercury exposure of the population studied, that is, Japanese eat much more fish than Swedish do. Fish contains mercury in high con-

centration than any other food and represents the principal source of mercury from food.

Table II shows the correlation coefficient between total mercury concentration in each two of these items. Although it has been noted by many reports (SUZUKI et al, 1971, TEJNING, 1968) that there was a correlation between hair and blood of a normal human, we could not observe the correlation between hair and blood of a maternal sample. A large portion of the mercury in blood is present as methylmercury and the methylmercury has a greater tendency to pass through the placental barrier to concentrate in the foetus than the inorganic mercury does (REYNOLDS et al, 1975, TAKAHASHI et al, 1971). Although the methylmercury could not be measured in the samples of this study being due to the limited amount of samples, it is not unreasonable to assume that the amount of methylmercury in maternal blood might derease and the proportion of methylmercury in total mercury might be changed in blood during the pregnancy. Therefore, no relationship of total mercury level may be observed between hair and blood of a mother in the present study.

On the other hand, WAKISAKA et al (1975) noted a significant correlation between maternal blood and neonatal blood for organic mercury concentration but not for inorganic mercury concentration. We observed that with regard to total mercury level there was a significant correlation between maternal blood and neonatal hair, or between neonatal hair and neonatal blood, respectively. However, we failed to see any correlation between the two of the other items as shown in Table II. Therefore, it is possible to predict the total mercury level in neonatal hair by the determination of total mercury in the maternal blood. However, it appears to be unexpected that the total mercury level in neonatal blood was foreseen from that of the mother's samples.

SUMMARY

Total mercury levels were determined with blood, hair and breast milk of mother-neonate pair sampled at the time of delivery. All of the thirty-four mothers are residents of Tokyo Metropolitan area. The maternal samples in general showed lower total mercury levels than those in the neonatal samples. A significant correlation was observed as regards the concentration of total mercury between the neonatal hair and maternal blood, and also neonatal hair and neonatal blood. But no correlation was noticeable on statistical basis between the other items of mother and her neonate.

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