Maternal and cord blood background mercury levels: A longitudinal surveillance

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Fifty-seven prenatal patients with no known exposure to the element mercury, or any of its compounds, were observed for change in whole blood total mercury concentration from the initial prenatal clinic examination through delivery and postpartum hospitalization. On hospital admission for labor and delivery, whole blood total mercury averaged 1.15 parts per billion (ppb), compared to 0.79 ppb from the first prenatal clinic visit; these levels represent a 46% increase and significant difference in maternal concentration of a substance previously recognized for its peculiar ease at crossing the placental barrier. Previous stillbirths, as well as history of birth defects, exhibited significant positive correlation with background mercury levels. Search of the literature of the last 5 years revealed no other report of cohort heavy metal surveillance throughout pregnancy. (Am. J. Obstet. Gynecol. 143:440, 1982.)

Mercury as an environmental contaminant is of considerable concern because of its well-documented toxicity for the fetus. As reviewed by Koos and Longo,1 epidemics of organic mercury poisoning in recent years in Japan, Soviet Russia, and Iraq have been associated with brain damage in infants in spite of little or no evidence of maternal toxicity, suggesting that the fetus either is exposed to higher levels than its mother or is especially sensitive to injury. It seems likely that both mechanisms are operative.

Reports of mercury levels in maternal and cord blood from populations with normal exposure have yielded widely disparate results. The lowest values reported were found in a study from our laboratory2 in

| Table I. Total mercury levels (in parts per billion) in maternal and cord blood |
|-----------------------------|-----------------|-----------------|----------------|----------------|
|                            | Maternal blood   | Cord blood      |
|                            | Prenatal         | Delivery        | Post partum    | Cord blood     |
| Mean                       | 0.79             | 1.15            | 1.21           | 1.15           |
| SEM                        | 0.12             | 0.10            | 0.14           | 0.18           |
| Range                      | 0.50             | 0.57            | 0.55           | 0.50           |

which the subjects were from rural Iowa. The principal purpose of the present investigation was to examine maternal and cord blood mercury levels from an urban population in Iowa, for comparison with earlier observations in rural subjects. Additional aims included delineation of any changes in maternal blood levels during pregnancy and correlation with potential sources of mercury exposure.

Subjects and methods

Subjects were recruited from among unselected patients registering for obstetric care at Broadlawns–Polk County Medical Center, Des Moines, Iowa, during the period January 1 through July 31, 1979. Each subject completed a questionnaire that included demographic data (age, parity, residence), potential sources of mercury exposure (occupational exposure, dental fillings,

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440
smoking habits), and past medical and obstetric history. Information regarding pregnancy outcome was gathered by examination of hospital records after delivery.

Maternal blood was drawn by antecubital venipuncture at the time of the first prenatal visit, on admission to the hospital for delivery, and on the second postpartum day. Mixed arterial-venous umbilical cord blood was collected at delivery. All blood samples were collected in heparinized glass vacuum tubes and frozen and stored until analysis. Whole blood total mercury concentrations were measured with an atomic absorption spectrophotometry method developed in our laboratory and described in detail elsewhere. The lower limit of detection by this method is 1 part per billion (ppb); measurements of less than 1 ppb were considered equivalent to zero for calculation.

A total of 57 patients completed the study protocol (questionnaire; maternal blood samples at first prenatal visit, admission for delivery, and second postpartum day; and umbilical blood sample at delivery) and form the basis of this report. Data were entered on a four-phase system terminal and analyzed with an IBM 370/145 computer, using the Statistical Analysis System package. Spearman or Kendall tau B correlation coefficients were calculated, and means were compared by Duncan’s multiple range test.

**Results**

Total mercury levels at the three sampling intervals in maternal blood and in cord blood at birth are listed in Table I. The mean level on admission for delivery significantly (p < 0.05) exceeded that of the first prenatal visit, indicating a tendency for blood mercury levels to increase with advancing gestation. None of the other mean values listed in Table I differed significantly from another. Specifically, cord blood levels were similar to maternal values in labor and postpartum.

Table II lists correlation coefficients between the various sampling intervals. Maternal levels early in the prenatal course did not correlate significantly with any sub-
Table V. Mean total mercury concentrations (in parts per billion) in normal populations

<table>
<thead>
<tr>
<th>Place</th>
<th>Maternal</th>
<th>Cord</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>16.8</td>
<td>20.0</td>
</tr>
<tr>
<td>Sweden</td>
<td>6.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Nashville, Tennessee*</td>
<td>8.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Cleveland, Ohio**</td>
<td>3.4</td>
<td>3.9</td>
</tr>
<tr>
<td>Rural Iowa*</td>
<td>1.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Urban Iowa (present report)</td>
<td>1.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

*Gas chromatography; all other studies, atomic absorption spectrophotometry.

sequent values in either mother or infant. The only significant relationship was that between maternal blood on admission in labor and that obtained 2 days after delivery ($r = 0.39, p < 0.003$). The correlation between cord blood levels and maternal postpartum levels approached statistical significance ($r = 0.23, p < 0.09$).

Table III contains correlation coefficients between various demographic data and blood mercury levels. Maternal age, duration of residence in Iowa, gestational age, and birth weight exhibited no significant relationships with maternal blood levels at any sampling intervals. Significant negative correlations existed between cord blood mercury and maternal age and years in Iowa.

Table IV lists correlations between blood mercury levels and certain selected factors from past obstetric history (previous stillbirth or malformed infant) and possible mercury exposure (dental fillings, smoking, and alcohol usage). Previous stillbirth exhibited significant positive correlation with mercury levels in both mother and infant. There was also a tendency, which did not reach statistical significance, for maternal levels to relate to large numbers of dental fillings and tobacco usage.

The outcome of the present pregnancy was generally good. Gestational age at delivery averaged 39.8 weeks and birth weight 3,290 gm. There was only one perinatal death—a markedly premature infant of 28 weeks' gestational age with respiratory distress syndrome.

Comment

Table V summarizes studies reporting maternal and cord blood total mercury concentrations in populations exposed to normal amounts of environmental mercury. The levels observed in both of our studies are substantially below those reported from other areas. As pointed out previously, this may at least partly reflect methodology since our technique involves correction for any mercury contamination in chemicals and glassware. It also likely reflects variation in exposure. Japanese and Swedish diets include high-volume fish consumption and contaminated fish represents the principal food source of mercury. We suggested earlier that the difference between our observations and those from Nashville might reflect rural-urban differences in mercury exposure, but the similarity between our findings reported here and those described earlier argues against such an interpretation.

The present finding that maternal mercury levels rose to a statistically significant degree between the first prenatal visit and delivery suggests a tendency for increasing levels with advancing gestation.

Among the demographic data examined, the only significant relationships were negative correlations between maternal age and years' residence in Iowa and cord blood mercury levels. The inverse relationship with maternal age is difficult to explain in view of our earlier finding that maternal age correlated positively with maternal (but not cord) levels at delivery. The negative correlation with Iowa residence might reflect subjects who moved to this state from an area of higher exposure.

Among obstetric-related historical factors, a significant association was found between previous stillbirth and mercury levels in both maternal and cord blood. Previous malformed infants significantly correlated with prenatal background mercury levels. Except for smoking early in pregnancy, none of the historical data reflecting possible mercury exposure correlated significantly with blood levels, although patients with large numbers of dental fillings exhibited a tendency to higher maternal blood mercury levels.

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