SHORT COMMUNICATION

Determinants of Lead Level in Umbilical Cord Blood

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Lead levels were measured by atomic absorption spectrophotometry in umbilical cord blood samples of 205 consecutively born neonates and venous blood in 62 of the mothers. The mean (± SD) cord blood lead level was 4.7 ± 12.1 µg/dL. In the sub sample of 62 mother-baby pairs, the mean (± SD) cord blood lead levels were 1.6 ± 2.5 µg/dL and 2.0 ± 2.1 µg/dL, respectively. According to CDC risk categories, 92% babies were in Class I of which 87% had lead levels below 5 µg/dL. The mean (± SD) birthweight in <5 µg/dL category was 2640 ± 445 grams as compared to 2617 ± 408 grams in >5 µg/dL category. The mean (± SD) gestational ages were 39.1 ± 2.0 weeks and 38.1±2.0 weeks, respectively in the two groups (*P*=0.014). On multivariate linear analysis, lower gestational age significantly correlated with higher cord blood lead level.

Keywords: *India, Lead poisoning, Neonate, Umbilical cord.*

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Low birthweight, prematurity and retardation of cognitive development have been associated with exposure to lead *in utero*(1). High maternal blood lead level is an important indicator of risk to the fetus(2). The umbilical cord blood lead levels (UCBLL) indicate the degree of lead exposure to the fetus. In this study, we determined UCBLL and its clinical, social and environmental correlates in babies born at a tertiary care center in Nagpur, India. We also determined the venous blood lead levels (BLL) in the mothers of 62 of these newborns and correlated it with the mean UCBLL.

METHODS

This hospital based cross sectional study was conducted at Nagpur, India. Ethical clearance and informed consent were obtained. UCBLL estimation was done in 205 consecutive births. Besides baseline maternal and neonatal characteristics, records were made of habits such as use of eye cosmetic "*surma*" and exposure to house paint by interviewing the mothers of the newborns. Concomitant maternal venous blood levels were also estimated in a simple random sample of 62 neonates. Cord and maternal blood were collected in lead free EDTA vacutainers. The lead levels were analyzed at the National Environmental Engineering Research Institute (NEERI), Nagpur within 48 hours of sample collection by flameless atomic absorption spectrophotometry (Hitachi Z-8000) in parts per billion at a wavelength of 283.3 nm with a slit width of 1.3 nm using the method described by Lagesson, *et al*.(3). The detection rate of lead for the instrument was 1µg/L, with an average error rate of 5% for reproducibility of results.

UCBLL were classified in the different Center for Disease Criteria (CDC) risk categories(4). The ratio of means of UCBLL and maternal venous BLL was calculated in 62 cases. Univariate and the multivariate linear regression was used to determine the sociodemographic and environmental correlates of lead levels (sex of newborn, caste, education level of mother, birthweight, gestational age, head circumference, premature rupture of membranes, alcohol or tobacco use in mother, use of *surma* by mother and the presence of house paint in homes).

WHAT THIS STUDY ADDS?

- Umbilical cord blood lead levels correlate significantly with maternal blood lead levels and a lower gestational age.

RESULTS

The mean (± SD) gestational age, birthweight and head circumference of 205 neonates (56% males and 44% females) were 39±2 weeks, 2637±440 grams and 32.6±1.5 cm, respectively. 30% of the enrolled neonates were low birth weight (<2500 grams). The mean (±SD) UCBLL of all 205 neonates was 4.7±12.1 µg/dL (range 0 to 81.2 µg/dL). According to CDC categorization of risk level(4), 92% belonged to Class I, of which 87% were in ≥5 µg/dL category and 5 % were in >5 to ≤10 µg/dL category. Only six percent of the neonates were in the CDC risk category class IIIB. The risk categories of 62 concomitant maternal BLL were 98% in Class I and rest in Class II. In the cord blood samples from these randomly selected 62 cases, the mean UCBLL was 1.6±2.5 µg/dL (range 0 to 19.1 µg/dL) and the mean mother's BLL was 2.0±2 µg/dL (range 0 to 13.5 µg/dL) with a ratio of mean UCBLL to maternal BLL of 0.8 which was significantly corrlelated (R^2=0.6, P=0.000).

On univariate analysis, UCBLL was significantly associated with gestational age, house paint, and maternal education but not associated with caste, use of eye cosmetic, tobacco or use of alcohol. The mean UCBLL in those homes that had no paint (n=119) was 3±6.9 µg/dl as compared to 6.9±16 µg/dl in those that had some or complete paint (n=86). In those with UCBLL >5 µg/dL, the mean gestational age was 38 weeks compared to 39 weeks in those with ≤5 µg/dL. On multivariate linear regression, gestational age reduced by a week for every 1 µg/dl increase in mean UCBLL.

DISCUSSION

In our study, a low prevalence of toxic lead levels was seen in the cord blood samples and the maternal venous samples. Although different populations have different environmental exposures, it is possible that a global awareness regarding lead toxicity has brought about a consistent decrease in the toxic lead levels over the years across different studies. In a study conducted at Mumbai, it was found that there was a reduction in pediatric blood lead levels in 2002 as compared to 1997 after phasing out of leaded petrol(5). This emphasizes the role of environment friendly legislations.

The correlation of UCBLL to mother's venous BLL, as found in our study, is in agreement to other studies which report that maternal lead level is an important determinant of fetal lead exposure and that the cord lead level is a good indicator of maternal levels(1). Therefore the demographic and environmental factors contributing to elevated maternal lead levels need to be examined. In this study, house paint and higher maternal education were associated with high UCBLL but the results did not reach statistical significance. The use of house paint was observed in the family of two-thirds (69%) of neonates with UCBLL >10 µg/dL. Other correlates such as caste and use of *surma* (eye cosmetic) by mother did not have significant impact on the umbilical cord lead levels. In another study conducted in Nagpur, in 1997-98, house paint was found to be a major determinant of lead levels in children(6). In our study, there was a significant correlation found between the UCBLL and gestational age in multivariate linear regression. It showed that one microgram increase in mean UCBLL was associated with reduction in gestational age by a week. An earlier study has also shown increased incidence of early deliveries in women with high blood lead levels where the mean BLL was 11.2 µg/dL at parturition and there were 5.3% preterm deliveries(1).

To conclude, this is the first report of the mean lead levels in cord blood of apparently healthy newborns and their mothers' environmental correlates from India. The most interesting finding was reduction in gestational age with high cord lead levels. The effect of toxic levels of lead on infant's

birth weight and gestational age requires further exploration by well-controlled studies from diverse settings.

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