Concentrations of Lead in Capillary Blood of Newborns

Norman P. Kubasik and Michael T. Volosin

Lead concentrations in whole blood have been determined for a random sampling of newborns (age 1–8 days) with the use of a microtechnique involving carbon rod atomization and atomic absorption spectrophotometry. The mean lead concentration of the newborns (13.8 ± 4.5 µg/100 ml of whole blood) significantly differed from that of pediatric populations at low (22.6 ± 6.1) and high lead (32.1 ± 10.4) risk. The concentration of lead in amniotic fluid was less than 20 ng/100 ml of fluid. The significance of the newborn lead values and their role in fetal development remains to be determined.

Additional Keyphrases amniotic fluid • carbon rod atomization • atomic absorption spectrophotometry • environmental pollution • pediatric values

Few studies in the literature report on blood lead concentrations in “nonexposed” individuals (newborns). In 1958, Robinson et al. (1) reported data on the lead in blood of infants ranging in age from five hours to six days. The data was part of a larger study of pediatric populations. The average lead level was about 17 µg/100 ml of whole blood. Scanlon (2), in 1971, reported the lead concentration in the cord blood of urban and suburban infants to be 22.1 and 18.3 µg/100 ml, respectively. The difference was not considered to be statistically significant. Harris and Holley (3) recently reported average cord blood lead concentrations of 12.3 µg/100 g of whole blood. The average value was considerably lower than that reported by Scanlon and no difference was observed between urban and suburban population groups. Rajegowda et al. (4) determined cord blood concentrations in 100 samples and reported a mean of 14.6 µg/100 ml.

Because of the growing awareness of lead as an environmental poison and the need for further information concerning baseline values for lead in blood in the “nonexposed” individual, we began the following study and report here our findings for capillary blood lead concentrations in newborns.

Methods and Materials

Lead in whole blood was measured by a recently developed microtechnique (5), in which a carbon rod atomizer (Model 61; Varian Techtron, Melbourne, Australia) is used in conjunction with an atomic absorption spectrophotometer (Model AA-5, Varian Techtron). In brief, the method requires 50 µl of whole blood and involves only a dilution of the whole blood for analysis. Capillary blood was collected from newborns by a heel puncture and from older children by a finger puncture. The sample was collected in a lead-free disposable 50-µl capillary tube (“Microcaps”; Rochester Scientific, Rochester, N.Y. 14624) after carefully cleansing the heel or finger with a 3% hexachlorophene solution (“pHisoHex”) for 1 min, followed by a rinsing with de-ionized water. The blood was immediately dispensed into a 2 ml minimal-lead disposable tube (No. L3272—XF-283; Becton, Dickinson and Co., Rutherford, N.J. 07070) containing 100 µl of a “Triton X-100” solution (50 ml/liter) and mixed. One microliter of the above dilution was then placed in the carbon rod for analysis as previously described (5). All samples were drawn and assayed in duplicate.

Results and Discussion

Table 1 gives values for capillary blood lead obtained from a random sampling of 20 newborns (age 1–8 days), and compares the results to both a low lead risk and high lead risk pediatric population. The low lead risk comprised 17 children from a local suburban population.

<p>| Table 1. Lead Concentrations for Capillary Blood in Newborns and in Low Lead Risk and High Lead Risk Pediatric Populations |
|-----------------|----------|--------|--------|--------|</p>
<table>
<thead>
<tr>
<th>Population</th>
<th>Age range</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
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<tr>
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<td>13.8</td>
<td>4.5</td>
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<td>17</td>
<td>22.6</td>
<td>6.1</td>
<td>14-32</td>
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<tr>
<td>High lead risk</td>
<td>1-6 a</td>
<td>84</td>
<td>32.1</td>
<td>10.4</td>
<td>14-62</td>
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From the Clinical Laboratories of the Genesee Hospital, 224 Alexander St., Rochester, N.Y. 14607.
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nursery school. The high lead risk group was a randomly selected urban inner-city pediatric population that was potentially subject to an increased lead hazard.

Statistical treatment (two-sided $t$-test) of the data showed that the mean of the newborn blood lead concentration was significantly lower than the means of both the low and high lead risk groups ($\alpha = 0.05$). The low and high lead risk groups were not significantly different ($\alpha = 0.05$).

The values in Table 1 represent lead in whole blood. It is well known that lead in blood is carried almost exclusively by the erythrocyte. When one takes into account the difference in hemoglobins between newborns and the older pediatric subjects, the observed lead differences are enhanced. Hemoglobins were not measured in children we tested, but if an average hemoglobin of 20 g is used for newborns and 13 g for the older pediatric groups, the following values in micrograms of lead per gram of hemoglobin were calculated: newborns, 0.69; low lead risk, 1.74; and high lead risk, 2.47.

We also attempted to measure lead in amniotic fluid by diluting one volume of amniotic fluid with one volume of concentrated nitric acid and applying 1 $\mu$l to the rod for analysis. Standards were prepared in a similar fashion. In all eight fluids assayed, the lead concentration was less than 20 ng/100 ml of fluid and was below limits of detection for the method.

Table 2 presents the values reported in the literature for blood lead in newborns. The data in this report appears to agree with the recently reported cord blood values of Harris and Holley (3) and of Rajegowda et al. (4).

The significance and importance of the lead values for newborns with regard to the fetus and feto-placental development are as yet unknown and the role of lead and other heavy metals remains to be determined.

<table>
<thead>
<tr>
<th>Study</th>
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<th>Range</th>
<th>Method of analysis</th>
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<td>13.8</td>
<td>7–23</td>
<td>CRA and AAS*</td>
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<td>Rajegowda et al. (cord blood)</td>
<td>100</td>
<td>14.6</td>
<td>10–30</td>
<td>AAS</td>
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</tbody>
</table>

*CR A = carbon rod atomizer; AAS = atomic absorption spectrophotometry.

*The data of Scanlon is the average of urban and suburban infants.

*Lead values were reported to the nearest 5 $\mu$g/100 g of blood.

The skilled technical assistance of Ann Acomb and David Kraft are greatly appreciated.

References


Automated Hexokinase Procedure for Assaying Glucose in Urine, Serum, or Plasma

Hugh Y. Yee

A colorimetric hexokinase method is described for measuring glucose in urine with the AutoAnalyzer. Pretreatment of the urine is not necessary. Sampling rate is 50/h, sample requirement 0.13 ml. Absorbance is measured at 505 nm; Beer's law is followed to 300 mg/liter. Results obtained with this procedure and by one in which $\alpha$-toluidine was used in combination with glucose oxidase were highly correlated ($r = 0.998$). Glucose concentrations in serum or plasma may be determined by diluting the sample 10-fold. Bilirubin in concentrations up to 200 mg/liter do not significantly interfere. With a dilutor, 20 $\mu$l of plasma or serum is diluted to 0.2 ml directly from a capillary collection tube after centrifugation. Thus, a convenient, sensitive method is available for assaying glucose concentrations in pediatric specimens.

Additional Keyphrases pediatric specimens
AutoAnalyzer