Severe Lead Poisoning in Pregnancy

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Background.—Lead freely crosses the placenta. Consequently, gestational lead poisoning is not only harmful to the woman but also to the developing fetus, invariably producing congenital lead poisoning. The scope and consequences of severe lead poisoning in pregnancy (blood lead level ≥45 μg/dL) have not been well characterized.

Methods.—We reviewed our experience in the management of women with severe gestational lead poisoning. Additionally, we reviewed the literature on this disorder in an effort to identify patterns in etiology and outcome.

Results.—Over a 3-year period treatment was provided to 7 severely lead-poisoned women. A 25-year review of the medical literature identified an additional 8 cases. Among these 15 women, 70% were Hispanic, all of whom developed lead poisoning from the ingestion of soil, clay, or pottery (''*tierra*''). Other sources of lead poisoning were paint chip ingestion (n = 2), household renovation, and use of a complementary-alternative medication (bone meal). Lead poisoning was discovered in the third trimester in 12 (86%) subjects after the women presented with subtle but characteristic findings of severe lead poisoning, including malaise, anemia, or basophilic stippling on blood smear; one woman was identified when she presented after a generalized seizure, having a blood lead level of 104 μg/dL. Five women received chelation therapy during pregnancy with $CaNa^2$ EDTA, dimercaprol, or succimer. At delivery mean maternal blood lead level was 55 μg/dL, whereas mean neonatal lead level was 74 μg/dL ($P = .009$). Thirteen neonates underwent chelation, all within the first 28 days of life. No infant in the current series had an identifiable birth defect.

Conclusions.—On the basis of this experience we conclude that severe lead poisoning in pregnant women has the following characteristics: 1) it most often occurs because of intentional pica, 2) its presenting features are subtle, often consisting only of malaise and anemia, and 3) blood lead levels in the neonate are higher than simultaneous maternal lead levels.

KEY WORDS: lead poisoning; pregnancy

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Childhood lead poisoning, although decreasing in prevalence, continues to affect an estimated 900 000 children.[1] Efforts to prevent lead poisoning rely on the identification of common sources and appropriate preventive interventions. Potentially included among lead sources of importance is in utero lead transmission. According to recent estimates, as many as 0.5% of women of childbearing age may have blood lead levels >10 μg/dL.[2] Because lead freely crosses the placenta, neonatal lead poisoning is always the expected result of lead poisoning in the pregnant woman.[3]

Severe lead poisoning (blood lead level ≥45 μg/dL) occasionally occurs in pregnant women. However, despite several published case reports of this condition over the last 30 years, there has been no effort to characterize its etiology and characteristics. Over the last 3 years, our Pediatric Environmental Specialty Unit has consulted in the care of pregnant women discovered to have severe lead poisoning. We reviewed our experience with these patients, additionally conducting a 25-year review of the medical literature to identify similar cases. Our purpose was to describe the epidemiologic and toxicologic aspects of severe lead poisoning in pregnancy as well as short-term neonatal outcomes.

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RESULTS

Over a 3-year period we assisted in the care of 7 severely lead-poisoned women. A Medline search identified an additional 8 cases (Table). Among the 15 women in whom ethnic origin was identified, 7 (70%) were of Hispanic origin, 2 were from India, and 1 was Caucasian; ethnicity was unstated in 5 cases. Mean gestational age at the time of diagnosis was 32 weeks, with all but 2 women in their third trimester. Initial maternal blood lead level was 72 ± 27 μg/dL. All women presented with malaise, fatigue, and anemia; in 2 cases the presence of basophilic stippling led to the diagnosis. One woman requested a blood lead measurement after she completed a household renovation project.

Where the source of lead poisoning was identified, 10 (83%) women admitted to intentional pica during pregnancy. In the Latina women, pica took the form of ''tierra,'' or ingestion of soil/clay-based substances, including clay pottery. Additional etiologies were home renovation and daily use of lead-contaminated bone meal, which was taken as a calcium supplement.

Five women underwent chelation while they were pregnant for a mean lead level of 86 μg/dL. Four received parenteral $CaNa^2$ EDTA, including one woman who also received intramuscular dimercaprol (BAL); one woman received succimer. The remaining 10 women carried the pregnancy to term without undergoing chelation. No adverse effects on either the mother or fetus were observed during chelation.

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Reported Cases of Severe Lead (Pb) Poisoning During Pregnancy, 1975–2000

Ethnic Origin	Gestational Age (w)	Initial [Pb] (μg/dL)	Source	Maternal [Pb] at Delivery (μg/dL)	Neonatal [Pb] (μg/dL)	Neonatal Chelation	Reference
Indian	33	104	Not stated	104	207	Succimer	Current series
Latina	35	61	Tierra	61	55	EDTA	Current series
Latina	32	117	Tierra	81	67	EDTA	Current series
Latina	35	49	Tierra	49	51	UK	Current series
Latina	35		Tierra cotta	55	87	Succimer	Current series
Latina	38	40	Tierra	40	26†	Succimer	Current series
Indian	34	66	Bone meal	50	62	EDTA	Current series
Not stated	25	62	Not found	58	126	BAL/EDTA, Succimer	4,5
Latina	"3rd trimester"	50	Not stated	60	37	EDTA	30
Latina	"3rd trimester"	57	Tierra	64	84	Succimer	31
Not stated	32	130	Tierra	48*	78	BAL/EDTA	32
Not stated	16	55	Tierra	48	78	EDTA	32
Caucasian	32	57	Occupational	33	70	None	33
Not stated	36	86	Paint chip ingestion	26*	60	EDTA	34
Not stated	38	79	Paint chip ingestion		79	EDTA	25

*After EDTA chelation.
†Measured on day of life 7.

At the time of delivery, mean maternal lead level was 55 ± 19 μg/dL; where reported, mean hematocrit was 29.5% (range 23%–32%). The corresponding neonatal lead level was a mean 74 ± 44 μg/dL (range 26–207 μg/dL), with hematocrit ranging from 35% to 52%. Neonatal blood levels correlated well with maternal level (Pearson bivariate correlation, $r = 0.72$, $P = .008$). Although mean neonatal blood lead level was significantly greater than maternal level ($P = .009$), newborn values ranged from 99% higher to 112% lower than maternal specimens, with a mean of 32% greater.

No newborn had an identifiable birth defect in the current series. However, among cases reported in the literature, neonates had skeletal abnormalities, including delayed skeletal maturation and distal long-bone sclerosis. Thirteen newborns underwent chelation therapy, all within the first 28 days of life, receiving EDTA, BAL, or succimer. No adverse effects of chelation were observed in the neonates. Neurodevelopmental monitoring is ongoing.

Case Descriptions

Case #8

A woman in her 25th week of gestation was found to have a blood lead level of 62 μg/dL, with a corresponding hematocrit of 23%. She received oral chelation with succimer. At term she delivered a healthy-appearing female. At delivery the maternal lead level was 58 μg/dL, whereas cord blood lead level was 126 μg/dL and neonatal lead level was 75 μg/dL. The newborn underwent chelation with parenteral BAL and EDTA.[4,5]

Case #2

A Hispanic woman presented to her obstetrician at 36 weeks with a lead level of 49 μg/dL. After repeated questioning, she admitted to the ingestion of clay pottery, describing this as a common practice in her culture. She did not undergo chelation. Labor began spontaneously at 36 weeks, with birth of a healthy-appearing female. At delivery maternal lead level was 49 μg/dL; simultaneous neonatal lead level was 51 μg/dL. Neither mother nor infant underwent chelation.

DISCUSSION

In addition to the 15 cases described here, there have been other reports of severe gestational lead poisoning published in the last century.[6–8] Collectively, these cases illustrate several consistent aspects of this poisoning, providing some insight into its causes and effects. For example, all cases resulted from one of 3 factors: intentional pica, home renovation, or use of a dietary supplement. Ingestion of soil or clay during pregnancy is a common practice among many ethnic groups[9,10]; this series indicates that pica during pregnancy is a significant risk factor for lead exposure. The case of renovation-associated lead poisoning illustrates the risk to pregnant women of participating in household renovation activities.[11] Finally, use of complementary/alternative medications has resulted in many reported cases of adult and childhood lead poisoning.[12–14] Bone meal and shells, often used as calcium supplements during pregnancy, have frequently been found to be lead-contaminated.[15–17]

Transplacental transmission of lead occurs by simple diffusion, with neonatal blood lead levels approximating those of the mother in most series.[2,3,18–20] However, uptake of lead by the fetus is cumulative over time, indicating a net unidirectional flow.[2,18] Additionally, data by Rothenberg and others[18,21] indicate that neonatal lead levels tend to be higher in the offspring of women with low calcium intakes.

An important but confounding factor in the interpretation of blood lead levels is hematocrit. Ninety-nine percent of circulating lead is bound to the erythrocyte. Therefore, in the presence of anemia, whether it is caused by iron deficiency or lead-induced suppression of hemato-

poiesis, blood lead level will be deceptively low. Conversely, because neonates typically have a hematocrit of 50%–60%, potentially as much as twice the maternal concentration, neonatal blood lead level will be markedly elevated (unless there is concomitant anemia).

Five women underwent chelation, all during the second or third trimester of pregnancy, with no obvious adverse effects to either the woman or fetus. Chelation was conducted in accordance with current guidelines, placing the mother's health as the treatment priority.[2] There are no known dangers of chelation therapy to pregnant women. Fetal effects are also uncertain; although experimental data have suggested that the elimination of essential minerals by chelation is teratogenic, there are no reports of chelation-associated birth defects in humans.[2,22] Nonetheless, chelation therapy potentially carries the added risk of mobilizing maternal lead stores such that lead transmission to the fetus increases. These observations support current recommendations that chelation during pregnancy be preserved for severe, symptomatic lead poisoning.[2,23]

The consequences of severe in utero lead poisoning on the newborn are unclear. No infant demonstrated overt signs of severe lead toxicity (eg, seizures). However, radiographic abnormalities, including delayed skeletal maturation and long-bone sclerosis,[24] are recognized consequences. Profound delays in the appearance of primary dentition may also occur, with the first tooth appearing as late as 30 months of age.[7,25] Other reported effects of lead on the fetus include intrauterine growth retardation, congenital anomalies, and neurobehavioral deficits.[2,26,27]

These cases indicate a role for targeted lead screening in pregnant women.[28,29] Use of a modified childhood questionnaire for lead exposure has been shown to be a useful aid in identifying lead-exposed women.[29] Based on our findings, a history of pica or use of a complementary/alternative medication during pregnancy may also be useful predictors of lead exposure. Prompt identification of such women would help to eliminate additional exposure and provide a lead-safe environment both for the woman and infant.

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