Blood Lead Levels in Children With Foreign Bodies

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ABSTRACT. To determine the risk of increased blood lead levels in children with aural, nasal, or gastrointestinal foreign bodies, the authors prospectively obtained venous blood lead and erythrocyte protoporphyrin levels from 40 study patients and two control groups without foreign bodies (65 patients presenting to a medical clinic and 40 patients presenting to an emergency department). A questionnaire was used to assess environmental and behavioral risk factors for lead poisoning in the three groups. Mean blood lead level was higher in children with foreign bodies (*P* < .001), and they were more likely to have a venous blood lead value of more than 1.2 μmol/L (25 μg/dL, *P* < .01) than patients in either control group. Seventy-eight percent of study patients had no prior lead screening by parent's report vs 64% of emergency department control subjects and 55% of medical clinic control subjects. Control patients in the emergency department had the same incidence of elevated blood lead values as patients enrolled from the medical clinic (6%). No differences in environmental risk factors were found among the three groups. Study patients more often had a history of pica or ingestion of a poison than control patients from the medical clinic. Inner-city children with foreign bodies have increased lead exposure and may have an increased risk for lead poisoning. In areas of high prevalence of lead poisoning, children with foreign bodies should be screened for lead poisoning in the emergency department. General lead screening in the emergency department may be justified for high-risk, inner-city populations. ***Pediatrics*** **1992;89:593-596;** ***foreign bodies, blood lead levels, lead toxicity, emergency department.***

ABBREVIATIONS. GI, gastrointestinal; ED, emergency department; EP, erythrocyte protoporphyrin.

Diagnosis and optimal treatment of lead poisoning require screening of pediatric patients at risk because affected children are usually asymptomatic. Current Centers for Disease Control guidelines focus on children near environmental sources of lead such as dilapidated housing, recently renovated homes, industrial sites of lead smelting, household members with occupational lead exposure, and inner-city pollution. These guidelines also target children at risk due to increased lead absorption, including those aged 9 months to 6 years and siblings or playmates of patients with lead poisoning.[1]

Previous research has identified behaviors that increase or are associated with increased lead absorption including pica, digital sucking, mouthing of nonfood items, and accidental ingestions.[2-7] Our experience suggests that an additional behavior, placing foreign bodies in the ear, nose, or gastrointestinal (GI) tract, is prevalent in lead-poisoned children. While reports have described lead poisoning following retention or ingestion of leaded objects such as bullets, shrapnel, shotgun pellets, or curtain weights,[8-10] there are no studies of lead poisoning in children who are found to have unleaded foreign bodies. It is also the authors' anecdotal experience that patients with unleaded foreign bodies do not routinely receive lead screening though many would consider this behavior to be a variant of pica. We hypothesized that these children would have increased blood lead levels compared with a control group with similar Centers for Disease Control risk factors.

METHODS

Patients were enrolled prospectively from March 1987 to October 1989. Children younger than 6 years of age, presenting to an urban pediatric emergency department (ED) with an aural, nasal, or GI foreign body, comprised the study group. Children younger than 6 years of age, presenting to the same hospital's general pediatric clinic or ED between the months of May and October, served as control subjects. No enrolled patient had a previous diagnosis of lead poisoning. This study was approved by the institutional review board of the hospital, and informed consent was obtained from all parents.

Blood samples for venous lead and erythrocyte protoporphyrin (EP) determinations were obtained by standard venipuncture technique with precautions to avoid specimen contamination. The Philadelphia City Health Department performed the laboratory studies using atomic absorption spectrophotometry for lead values and the extraction method of Piomelli for EP.[11,12] An increased blood lead level was defined as a venous blood lead concentration greater than 1.2 μmol/L (25 μg/dL).

Parents of all patients completed a face-to-face questionnaire covering the following environmental and behavioral risk factors for lead poisoning: age of patient, race, age of housing, recent home renovation, presence of peeling paint in the home, leaded pipes in the plumbing, home near a major factory, household member with an occupational exposure to lead, siblings with lead poisoning, and patient history of ingestion, pica, or digital sucking. In addition, we recorded gender, insurance payment status, address, history of prior foreign body or lead screening, foreign body type, and foreign body site (when applicable).

We analyzed categorical data by χ^2 analysis. Odds ratios with 95% confidence intervals were calculated for significant findings by the exact method.[13] We used the Kruskal-Wallis H test for nonparametric data and considered a *P* value less than .05 significant.

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RESULTS

The study group consisted of 40 patients. Sixty-five control patients were enrolled from the medical clinic and 40 were enrolled through the ED. The groups did not differ by gender, age, race, or location (Table 1). Mean age was 39 months for study patients, 35 months for medical clinic control subjects, and 33 months for ED control subjects. Boys predominated in all groups. The majority of patients were black. Most patients in all groups resided in the low-income, inner-city neighborhood of West Philadelphia.

Study patients and ED control subjects had private insurance more often than medical clinic patients (28% and 21% vs 11%, $P < .001$). More self-pay patients were also enrolled in the study and ED groups (33% and 24% vs 3%, $P < .001$). All patients received continuity care at local health or hospital clinics.

In terms of environmental risk factors for lead poisoning, the three groups did not differ by age of their dwelling, presence of peeling paint in their home, family member with occupational lead exposure, proximity to a major factory, or sibling with lead poisoning (Table 2). We noted the age of the prior dwelling in addition to the current home for patients who had moved in the previous 2 years. Recent moves to a new house were reported equally in all groups. Four of 40 study patients reported plumbing with lead pipes vs 11 of 65 medical clinic patients and 5 of 40 ED patients. Thirty-three study patients stated that their plumbing had no lead pipes. However, almost half of control subjects in the medical clinic and ED did not know the composition of their plumbing, so that a comparison for this risk factor could not be made. Medical clinic control patients more often had painted or renovated their house in the previous 10 years.

In terms of behavioral risk factors for lead poisoning, more patients in the study group had a history of a previous unleaded foreign body in the ear or nose. Prior ingestion or pica and lack of prior lead screening was more prevalent in the study group compared with the medical clinic group, but no significant difference was found for these behaviors between the study group and the ED group (Table 2). Digital sucking and mouthing of nonfood items were equally prevalent in all groups.

Patients with foreign bodies had a higher mean venous blood lead level (1.06 μmol/L vs 0.72 and 0.69 μmol/L, $P < .01$) and were more likely to have an elevated blood lead value (28% vs 6% and 8%; odds ratio = 6.0, confidence interval = 1.6,28; Table 3). In addition, among all children with elevated lead values, children with foreign bodies had a greater degree of blood lead elevation than control subjects (Table 4). These findings did not change when we stratified by foreign body site (ear/nose vs GI tract), source of payment (private, public, self-pay), or source of health care. A history of pica did not account for the higher mean blood lead values or degree of

TABLE 1. Demographics*

	Study Patients (n = 40)	Control Patients		*P* Value
		ED (n = 40)	MC (n = 65)	
Gender, male/female	2.1	1.8	1.4	NS
Age, mo (mean ± SD)	39 ± 14	34 ± 21	35 ± 18	NS
Race				
% Black	93	87	97	NS
% Other	7	13	3	NS
Location by zip code, No.				
West Philadelphia	24	19	40	NS
Southwest Philadelphia	5	2	4	NS
South Philadelphia	8	3	8	NS
North Philadelphia	2	12	9	<.001‡
Other†	1	0	4	NS

* Ed, emergency department; MC, medical clinic; NS, not significant.
† Discounting these patients in analysis did not change results.
‡ Significant for ED vs study patients only.

TABLE 2. Environmental and Behavioral Risk Factors for Lead Poisoning*

Risk Factor	Study Patients, %	Control Patients		*P* Value	Odds Radio (Confidence Interval)
		ED, %	MC, %		
Age of house > 25 y	64	57	63	NS	...
Peeling paint in house	35	36	43	NS	...
Recently painted house	70	83	89	<.05†	0.3 (0.1,0.9)
Lives near factory	18	8	20	NS	...
Occupational lead exposure	8	5	3	NS	...
Siblings with lead poisoning	5	5	6	NS	...
Prior foreign body	69	25	26	<.001	6.4 (2.4,17)
History of pica	28	11	9	<.05†	3.7 (1.1,13)
No lead screening	78	64	55	<.05†	2.9 (1.1,8)
Digital sucking	30	36	23	NS	...
Mouthing	80	81	67	NS	...

* ED, emergency department; MC, medical clinic; NS, not significant.
† Significant for study vs MC control patients only.

TABLE 3. Blood Lead and Erythrocyte Protoporphyrin Values*

Group	No.	Mean Pb, μmol/L†	Mean FEP, μmol/L RBC‡	Pb > 1.2 μmol/L, %
Study patients				
All	40	1.06 ± 0.58	0.7 ± 1.2	28
FB ear/nose	26	1.01 ± 0.48	0.5 ± 0.3	27
FB GI	14	1.11 ± 0.77	1.0 ± 2.0	29
History of pica	11	0.94 ± 0.30	0.4 ± 0.1	36
Control patients				
MC	65	0.72 ± 0.6	0.5 ± 0.2	6
ED	40	0.69 ± 0.3	0.5 ± 0.3	8
History of pica	10	0.58 ± 0.2	0.6 ± 0.2	0
P value§		<.01	NS	<.05

* Pb, venous blood lead level; FEP, free erythrocyte protoporphyrin; RBC, red blood cells; FB, foreign body; GI, gastrointestinal; ED, emergency department; MC, medical clinic.
† μg/dL (Pb) = μmol/L (Pb) × 20.7.
‡ μg/dL RBC (FEP) = μmol/L RBC (FEP) × 56.2.
§ *P* value reflects comparison of combined study group with the control groups.

TABLE 4. Comparison of Blood Lead Elevation*

Group	Blood Lead Level†			
	1.2–1.45 (25–30)	1.46–2.37 (31–49)	2.38–3.33 (50–69)	> 3.33 (> 70)
Study patients	4	5	1	1
Control patients				
MC	4	0	0	0
ED	1	2	0	0

* Results represent numbers of patients. MC, medical clinic; ED, emergency department.
† Blood lead levels are given as micromoles per liter (micrograms per deciliter).

blood lead elevation seen in the study group (Table 3). All blood lead levels in the control groups were obtained between the months of May and October. Seventy percent of study patients presented with foreign bodies during this period. One of these study patients had unrecognized class IV lead poisoning requiring immediate chelation. Two patients with foreign bodies had elevated blood lead values discovered between November and April. No control patient had a blood lead value greater than 1.59 μmol/L (33 μg/dL). There was no difference in EP values among the three groups.

DISCUSSION

Lead poisoning remains a common problem, particularly among inner-city children. Recent national surveys estimate that 1.5% of children have lead levels exceeding 1.2 μmol/L (25 μg/dL).[14] In Philadelphia, the prevalence of lead poisoning, defined as a venous blood lead level greater than 1.2 μmol/L or EP level greater than 2.4 μmol/L (50 μg/dL), was 3% among the 20 000 children screened during 1989 (Richard Tobin, Program Director Philadelphia Childhood Lead Poisoning Prevention Program, oral communication, March 1990). Children with lead poisoning suffer a variety of physical effects including permanent deficits in cognition, behavior, and development.[15] This potential for irreversible damage from lead toxicity mandates screening for lead poisoning in all children, especially those with high levels of lead exposure.

Our data show that children who are found to have foreign bodies in their ear, nose, or GI tract have higher mean blood lead values than medical clinic and ED control patients with similar environmental risk factors for lead exposure. Children with foreign bodies also are more likely to have a venous blood lead value greater than 1.2 μmol/L. Note that we detected this difference despite a 6% prevalence of elevated blood lead level in our control groups (twice the current prevalence of lead poisoning in the city of Philadelphia). While venous blood lead level does not reflect total body lead burden, it is an indicator of lead exposure. Thus, our findings suggest that children with foreign bodies have significant lead exposure and may be at increased risk for lead poisoning.

Erythrocyte protoporphyrin values did not differ in our study. This finding probably reflects a high prevalence of iron deficiency in our samples, though we did not concurrently screen all participants for this problem. Previous work has shown that elevation of EP caused by iron deficiency in the presence of elevated blood lead is small.[16] Therefore, we attribute the lack of difference in EP values to elevation of EP in control patients with iron deficiency.

Environmental risks for lead poisoning were almost identical in each patient sample with the exception that almost a third of our study population had blood values obtained during the winter months. This difference would favor lower blood lead values in the study group.

Twenty-eight percent of our children with foreign bodies had a history of pica or ingestion. This finding suggests that foreign body placement may be a marker for pica in our patients. It is possible that some of the study patients without a history of pica may have actually exhibited this behavior, but in these instances, it would be the presence of the foreign body, not the presence of pica, that brought these children to medical attention and allowed for appropriate lead screening. Under normal circumstances, these patients would not have been screened in a timely matter, and the 11 study patients with lead poisoning would have gone undetected.

Seventy-five percent of our study patients were previously unscreened for lead poisoning. Surprisingly, 64% of our ED control parents and 55% of our medical clinic control parents also reported no prior lead screening despite a mean age of almost 3 years in all groups. Medical records for the clinic group were reviewed and found to correlate well with parent's report. No review was possible for the study group or the ED control group. However, these data suggest that many unscreened children present to the ED. In high prevalence areas for lead poisoning, ED-based screening efforts may be justified. In addition, these data underscore the need for surveillance of medical clinic populations to ensure adequate lead screening.

Our data are limited by a reliance on subjective parental responses for an estimation of environmental and behavioral risk factors. Physical features of a home that place its inhabitants at risk for lead poisoning are easily observed, however. Of the questions concerning environmental risk factors, parents only had difficulty reporting the presence of lead pipes in the home. Given the similarity in age of the home among all groups, it is likely that lead pipes would also be equally found in the homes of our patients. Certainly, most of our patients are at high risk for lead poisoning simply because they live in low-income neighborhoods of Philadelphia.

Behavioral risk factors are more prone to inaccuracy because parents might be unwilling to report actions they perceive as socially unacceptable, such as thumb sucking or pica. The prevalence of pica seen in our study group is comparable with the 32% prevalence found by previous study in black children.[4] Similarly, digital sucking and mouthing behaviors in all of our groups were very close to the 28% and 80% prevalence noted for these behaviors by Barltrop.[6] Thus, underreporting of behavioral risk factors seems to be an unlikely source of bias in this study.

In conclusion, we found that children with foreign bodies have high levels of lead exposure and appear to be at significant risk for lead poisoning compared with an ED and a medical clinic inner-city control group. For this reason, we recommend that children who are found to have aural, nasal, or GI foreign bodies should be screened for lead poisoning.

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HAPPINESS IS ANTICIPATION NOT FULFILLMENT

Half the joy of materialism lies in the anticipation. Once you stop dreaming about a new possession and actually possess it, the "Is that all there is?" *tristesse* often sets in. Otherwise, children would enjoy Christmas afternoon as much as Christmas Eve. By the same reasoning, the more remote the moment of possession, the more wonderful the dreams can be.

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