Managing Children With Elevated Blood Lead Levels

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Part I: Background

1. Introduction

Advances in lead poisoning research, as well as changes in the epidemiology of lead paint hazards, have led to new management guidelines. The striking decrease in the number of children in Baltimore with elevated blood lead levels represents one of the dramatic changes in the epidemiology of lead poisoning. In 1993, I worked with Dr. Irene Oung, treating children admitted to the lead poisoning unit at Mt. Washington Pediatric Hospital. That year in Baltimore city, 14,546 children under the age of six years had elevated blood levels (23.9% of the children tested). In 2010, only 531 children in Baltimore City had elevated blood lead levels, a 98% reduction. Research led to a change in the criteria used for an elevated blood lead level in children. This extensive research, beginning in the early 1990's, documented that even blood lead levels less than 10 µg/dL resulted in neuropsychological impairment and loss of IQ points in children under six years of age. This finding led the CDC's Advisory Committee on Childhood Lead Poisoning in 2012 to change the definition of lead poisoning from a blood lead level of 10 µg/dL to 5 µg/dL. The purpose of this discussion is to present a summary of recent research findings and recommended management guidelines in three parts. Part 1 reviews the history of lead poisoning in Maryland and discusses lead paint hazards. Part 2 focuses on clinical manifestations of lead poisoning with a discussion of toxicokinetics, clinical effects and screening. Part 3 presents updated guidelines for the management of children with elevated blood lead levels.

2. History

Enactment of local, state and federal regulations and laws played an important role in reducing children's exposure to lead paint hazards, resulting in a dramatic reduction in the number of children with elevated blood lead levels. Regulation of lead paint began in 1941, when health officials in Baltimore recognized the magnitude of the growing lead poisoning epidemic and enacted the first city ordinance to control lead paint use. The city ordinance required owners to remove lead paint from a rental unit where lead was identified. Unfortunately, the ordinance was not enforced, due to opposition from powerful economic interests in the city. Officials succeeded in passing stricter ordinances in 1948 and 1951 that were also of limited success until the 1960's, when the city passed ordinances that held landlords liable.

At the forefront of lead poisoning research was a renowned physician, also connected to Baltimore: Dr. J. Julian Chisolm. While Dr. Chisolm was interning at Johns Hopkins Hospital, he was horrified by the death of a girl who had recently moved to a house near the hospital with extensive lead-based paint that was chipping, flaking and peeling. This experience led Dr. Chisolm and his team to three important innovations in the field of lead poisoning. In 1968, Dr. Chisolm introduced chelating agents to treat lead poisoning, which saved hundreds of children's lives. In addition, he helped to develop the fingerstick blood test in the 1980's, which identified children with lead poisoning at an earlier stage. Finally, Dr. Chisolm's studies showed that the neuropsychological impairment from lead poisoning could not be reversed, so he became an advocate for prevention, testifying frequently before Congress and leading to laws banning the use of lead in residential paint, as well as in gasoline.

3. Lead Paint and Lead Dust Hazards

Title X, the Residential Lead-Based Paint Hazard Reduction Act passed by congress in 1992, defined a lead-based paint hazard as any of the following:

- Lead-based paint on a friction surface such as a window sill
- Lead-based paint on an impact surface such as a door that rubs against the door frame
- Lead-based paint on a surface such as a window sill with chew marks
- Lead-based paint that is deteriorated with chipping, flaking and peeling.

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In 2011, I completed a lead-based paint risk assessment course at a Baltimore-based company, Connor Solutions, to learn the specific techniques and tools used to detect lead-based paint and dust hazards. An XRF (X-Ray Fluorescence) analyzer is a hand held device that has replaced analysis of paint chips as the primary method for detecting the presence of lead-based paint. The analyzer shoots a stream of gamma rays into a painted surface and can detect the presence of lead-based paint up to several layers deep. A lead paint hazard in Maryland is defined as a reading of >0.7 µg/cm2 (the national criterion is > 1.0 µg/cm2) and is considered the level that can be hazardous to a child's health. In Maryland, special training and certification are required for a person to become a lead paint assessment technician and use the XRF analyzer to detect lead-based paint. Lead-based paint was used in homes built before 1978, when federal laws banned its use in residences. Houses built before 1950 contained lead paint that had an even higher concentration of lead, posing a greater threat to children under six years of age. According to CDC surveillance data from 2009, 54% of homes in Baltimore city and 21% of homes in the state of Maryland were built before 1950.

A lead dust hazard is a surface that contains greater than 40 µg Pb/ft^2 and is determined by taking dust swipes using a standard technique. Dust sampling is used to detect the lead-contaminated dust that comes from deteriorating lead-based paint. Since young children under two frequently have hand-to-mouth activity, lead-contaminated dust is the most common cause of elevated blood lead levels. On occasion, lead-contaminated water or soil may contribute a small amount to a child's elevated blood level. Since 2012, Maryland law requires all rental properties to pass lead paint hazard inspection; dust sampling is the most common method used by inspectors

4. Child Elevated Blood Lead assessment (EBL)

In 2011, I evaluated in my office a 4 year old boy with hyperactivity and speech delay, and I found he had an elevated blood lead level of 21 µg/dL. I reported the results to our county health department, and they arranged for a special Child Elevated Blood Lead assessment with a technician from the Maryland Department of Environment. This special assessment is used for children with an elevated blood lead level and involves extensive environmental testing. I accompanied the risk assessor as we visited my patient's house, which had been built in 1970. First, she took an extensive environmental history, asking the family about: 1. any recent house renovation that could release lead dust into the air; 2. parental occupations that could involve exposure to lead; 3. my patient's visitations, i.e. day care and baby sitters outside the home that could be a source of exposure to lead. He did not go to a babysitter but did attend a preschool program at a nearby elementary school. She arranged later to visit the school and do environmental testing there. She took over 30 readings with the XRF analyzer in the child's bedroom, living room, play area, and kitchen. She also took over 30 dust samples from the same areas, and also from the dust in the family car and work shed. She took several soil samples from the yard where the swing set and play area were located, and she arranged for the health department to test the well water for lead. We inspected the kitchen for glazed pottery made in Mexico and leaded crystal that could be a source of lead poisoning. She inspected the dad's hobby room for fishing lures and shot gun shells that could contain lead. Inspection of the bathroom was also done to look for home remedies and make-up that could contain lead. Inspection of my patient's bed room was done to look for painted toys, painted furniture and vinyl miniblinds that could contain lead. All tests came back negative. The conclusion: the probable source was lead-containing cosmetics, which my patient used extensively for Halloween, but which were no longer available for testing.

Dr. Rogers attended the University of Maryland School of Medicine and did his pediatric internship at UCLA. After serving in the Public Health Service, he completed a fellowship in Neurodevelopmental Pediatrics at the Kennedy Krieger Institute. His interest in children with lead poisoning began in 1990, when he worked at Mt. Washington Pediatric Hospital and was involved in the care of many children admitted with lead poisoning. He is now in private practice in Bel Air, Maryland, doing primary care as well as consulting to families with children with neuro-developmental disabilities. In 2011, Dr. Rogers completed the course to be a lead paint hazard assessor for Maryland and DC. Recently, he helped review a draft for an update to the 2005 AAP policy on lead poisoning.