BEHAVIORAL OBJECTIVES

AFTER READING THIS NEWSLETTER THE LEARNER WILL BE ABLE TO:

1. Discuss four common sources of lead exposure in children.

2. Describe clinical manifestations of lead poisoning in children, as well as implications for the healthcare provider.

Poisoning from ingestion or inhalation of lead (Pb), as well as ingestion of iron (Fe) in toxic amounts, are leading causes of childhood poisonings in the United States. Despite efforts to prevent poisoning in childhood, such as potentially hazardous drugs and household products being sold in child-resistant containers, as well as lead being removed from house paint, poisoning remains a common cause of non-intentional injuries and death in young children. Most poisonings occur in children under 6 years of age and more than 90% occur in the home environment. Boys seem to be poisoned slightly more often than girls.

This newsletter will discuss common sources of iron and lead exposure in children. Clinical manifestations of poisoning from these substances, as well as implications for the healthcare provider, will be described.

IRON POISONING

Childhood poisonings caused by accidental overdoses of iron-containing supplements are the biggest concern of poison control experts. Multivitamin supplements that contain iron are a common medicine in American homes. Many children and adults, including nearly all pregnant and postpartum women, consume a multivitamin and/or iron supplement daily. Therefore, the potential for poisoning is widespread. The risk of poisoning also increases because multivitamins and minerals are often packaged in large quantities in individual containers. Additionally, children's vitamins are marketed to young children and may appear as candy, for example in the shapes of cartoon characters, and are chewable and pleasant taking. As parents are often unaware of iron toxicity, which can cause multi-system failure and death, they are typically left out in the open, such as on the kitchen table to be taken in the morning by the family. Parent education is key to prevent iron poisoning in children – all medicines should be in a locked or child-proof cabinet.

Typically, iron ingestions of less than 20 mg/kg have little risk of systemic toxicity. Symptoms are usually limited to GI symptoms. Ingestions of 40 to 60 mg/kg carry a risk of severe toxicity, and ingestions of 200 to 250 mg/kg are potentially lethal. Most prenatal vitamins contain between 27 and 60 mg of iron. Depending on age, from all sources, children should have only 7 -11 milligrams of iron each day.

Most poisons, with the exception of lead, work fairly quickly. This includes iron poisoning. Iron levels peak between 4 and 6 hours after ingestion. Typically, serum iron levels are measured when the child is brought in for treatment and every 1 to 2 hours thereafter until the serum iron level begins to decrease. Iron has a direct corrosive effect on the mucosa of the GI tract, leading to nausea and vomiting, diarrhea, melena (black, tarry stools), and hematemesis (bloody vomitus). These symptoms, which are often the presenting symptoms of iron poisoning, cause fluid losses from the GI tract, which can lead to hypovolemia.

Additionally, the iron-rich blood of the GI tract passes into the liver via the portal vein. The hepatocytes are damaged by the iron, which may lead to liver failure. Liver enzymes become increased, and coagulopathy develops, which increases the risk of bleeding and can further contribute to hypovolemia. Some children have permanent liver damage and may even require transplant. Because of poor perfusion, children may also develop acute renal failure. Poor perfusion can also lead to central nervous system symptoms, ranging from mild lethargy to coma.

Iron also directly damages the myocardial cells of the heart, which leads to decreased contractility and pump failure. In addition, iron causes direct vasodilatation, which leads to hypotension. Finally, iron damages the capillaries, which triggers capillary leakage and allows fluid to third-space. This leads to further hypovolemia and hypotension. Left untreated, death may result.

LEAD POISONING

Lead poisoning, also called plumbism, is caused by swallowing lead or inhaling its dust or fumes. Lead poisoning, elevated blood lead levels (EBLLs) of 10 mcg/dl or greater, is one of the most common environmental hazards of young children. Lead levels are measured in micrograms of lead per deciliter of blood (mcg/dl). In the past 30 years there has been a decrease in lead poisoning in children in the U.S. largely because of a reduction of lead in paint, gasoline, and food. One of the goals of the Centers for Disease Control (CDC) and Healthy People 2010 is to eliminate elevated blood lead levels in children in the U.S.
Currently, the CDC has set 10 mcg/dl, or lower as acceptable blood lead levels. Although progress has been made in reducing lead exposure in children, the Centers for Disease Control estimate 250,000 young children in this county have elevated blood lead levels.

Lead is a neurotoxic metallic element that is absorbed by the body, primarily through the lungs and stomach. Generally, lead poisoning results from the gradual accumulation of lead in bone and tissue after repeated exposure. Left untreated, lead poisoning can damage internal organs, including the brain and nervous system, as well as the kidneys. Lead poisoning is particularly dangerous during the critical developmental periods of infants and young children under the age of 6-7 years. Lead toxicity can cause behavioral problems and learning disabilities, as well as seizures and death.

Most children with lead poisoning do not appear sick. Blood levels must be extremely elevated before any symptoms develop. Clinical manifestations vary with blood level and age. Very high blood lead levels, greater than 70 mcg/dl, can cause coma, convulsions, and death. Lower amounts can cause central nervous system damage, kidney problems, and anemia. Children often give little indication of lead poisoning, or the signs may be mistaken for other illnesses. Typical symptoms include abdominal pain and cramps, irritability, fatigue, frequent vomiting, constipation, headache, sleep disorders, and poor appetite.

**SOURCES**

It is estimated that currently 1.2 million homes in this country are at risk for lead poisoning hazards for children. While the risk of exposure is higher in deteriorating inner-city neighborhoods, lead poisoning occurs in all social and economic groups. Major sources of lead exposure, particularly for children, include:

**Lead-based paint** remains the most common source of lead exposure for children less than 6 years old. Lead-based paint is present in 75% of all U.S. homes built before 1980. Homes built before 1950 are even more likely to contain lead-based paint. According to the American Academy of Pediatrics (AAP) Committee on Environmental Health, nearly 74% of occupied homes are likely to contain lead paint. This is the biggest threat to children. Many layers of lead-based paint can be found on exterior and interior surfaces of older homes and on older cribs, playpens, playground furniture and toys.

Lead paint that is intact does not cause a risk. However, because of the oral phase of development, the young child is likely to put peeling or cracked paint in his or her mouth. In 1997, the Consumer Product Safety Commission banned the manufacturing of paint with more than 0.06% lead by weight. However, paint labels should be checked carefully and parents should avoid purchasing unlabeled or bargain paints, as they may contain lead.

The Federal Residential Lead-Based Paint Hazard Reduction Act requires sellers and landlords of homes built before 1978 to disclose the building’s lead test results to buyers or tenants. Any renovations done to an older home should be done before the family moves in. If a family lives in an older home, and it is not financially feasible to have lead paint completely removed, children should be supervised and kept away from peeling or chipping paint and chewable painted surfaces.

**Dust and soil** may contain chips and dust from exterior paint, lead-based insecticides, and highway pollution. Dirt near highways and busy streets often contains lead from gasoline, even though leaded gas has been banned since 1976. Artificial turf playing fields may also contain potentially unhealthy levels of lead dust.

**Drinking water**, which is contaminated with lead, contributes to 10% to 20% of lead exposure in young children. Pipes that contain lead can be identified by their dull gray color. They also scratch easily and are not attracted by a magnet. Lead water pipes, used between 1930 and the mid-1980s, and lead solder used to connect plumbing can contaminate water, particularly when corrosion occurs. In 1986, the use of lead-based solder was banned in water pipes. However, it remains in many homes.

Parents should be advised to contact their local health department or water supplier to inquire about having their water tested. One cannot see, smell, or taste lead, and boiling the water will not get rid of this metal. If bottled water is not feasible due to the cost, only cold water, which contains less lead than hot water, should be used for preparation of baby formulas and cooking. Use of a water filter that eliminates lead, either directly at the water faucet or a system using a pitcher, is helpful.

**Parents’ jobs**, such as working as a plumber, auto worker, printer, smelter, highway construction worker, chemist, or gas station attendant, or anyone repairing cars or boats, may predispose children to lead exposure. Additionally parental hobbies, including painting, furniture refinishing, or working with stained glass or ceramics, may put children in contact with items that contain lead, which they may put in their mouths or inhale. Children should be kept away from hobby areas where lead is being used. If parents work with lead, they should, if possible, shower before entering the home. Work clothes and shoes should also be washed separately from household laundry.

**Food** stored in poorly glazed pottery, lead crystal and antique pewter containers may contain lead. Additionally, food packaged and stored in cans with lead seams may contain lead. Acidic items especially, such as tomatoes and orange juice, may leach out the lead from leaded seams. Lead has been found in some candies imported from Mexico. Other products manufactured outside of the U.S., such as toys, trinkets, cosmetics and vinyl mini-blinds, may contain lead. In addition, hair dye, drapery and window weights, and some costume jewelry also contain lead. In 2004, a child had a EBLL of 123 mcg/dl after ingesting a necklace with high lead content. Ingestion of lead containing items, jewelry, trinkets and toys, has become increasingly more common as a source of life-threatening EBLLs.

**Healthcare providers play a key role in prevention of childhood poisoning in childhood. Anticipatory guidance and parent education related to sources and manifestations of iron and lead poisoning should be a routine part of care.**
IRON AND LEAD POISONING... PEDIATRIC RISK

1. Which of the following children is most at risk for poisoning?
   a. 4 year-old boy playing at home
   b. 9 year-old boy playing at the neighborhood playground
   c. 3 year-old girl playing at her preschool
   d. 7 year-old girl playing with friends at school

2. The cardiovascular system is one of the primary organ systems affected by iron poisoning.
   a. True
   b. False

3. Which of the following presenting symptoms is indicative of iron poisoning?
   a. shortness of breath
   b. seizure
   c. constipation
   d. hematemesis

4. Once ingested, what amount of iron carries a risk of severe, not lethal, toxicity?
   a. 20 mg/kg or less
   b. 40 to 60 mg/kg
   c. 100 to 150 mg/kg
   d. 200 to 250 mg/kg

5. How many hours after ingestion do iron levels peak in children?
   a. 1 to 2
   b. 4 to 6
   c. 12
   d. 24
6. Lead is:
   a. harmless to the body systems in normal levels of 20 mcg/dl.
   b. found in drinking water of homes with leaded pipes.
   c. most commonly found in shrubs near a house.
   d. found in low levels in vitamin supplements.

7. A child has the greatest risk of exposure to lead if a parent:
   a. is scraping off old paint in an older home while the family is living there.
   b. works in highway construction who showers and changes clothes before coming home.
   c. has a hobby of doing watercolor painting in the home.
   d. enjoys growing flowers and vegetables.

8. Which of the following products may contain lead?
   a. A metallic toy brought from another country to a young child
   b. Draperies made outside of the United States
   c. Shampoo
   d. Aluminum foil for covering food

9. Children with lead poisoning usually exhibit:
   a. abdominal pain.
   b. irritability.
   c. frequent vomiting.
   d. no apparent symptoms.

10. To quickly assess the risk for lead poisoning in a two year old, the healthcare provider should ask the parent, “Does your child:
    a. have any learning disabilities or seem extremely fatigued?”
    b. have exposure to a place that has peeling or chipping paint?”
    c. experience intermittent vomiting?”
    d. drink orange juice and eat canned tomatoes?”