periFACTS® OB/GYN Academy
Obstetric and Fetal Monitoring Course
Case #1108

Date of release: October 1, 2014 **Period of Validity: October 1, 2014 through October 31, 2014**

About the Program
periFACTS® is a self-instructional program designed to assist obstetric healthcare professionals in the acquisition of the knowledge and expertise needed to provide quality care for childbearing women.

This online, enduring material has been developed from the content of the periFACTS Program, presented by the Department of Obstetrics and Gynecology at the University of Rochester School of Medicine and Dentistry in Rochester, NY.

Target Audience
This educational content is intended for obstetric care providers.

Learning Objectives
After completing the program modules, participants should be able to:

- Identify factors that place the maternal-fetal unit at risk and how they may present on the fetal heart rate tracing.
- Discuss the clinical assessment, including fetal heart rate interpretation, and nursing management of common obstetric problems.
- Recognize and discuss the physiologic factors affecting the maternal-fetal unit and how they may present on the fetal heart rate tracing.
- Present the National Institute of Child Health and Human Development's vocabulary and classification system for fetal heart rate interpretation.
- Describe components of fetal heart rate patterns: baseline fetal heart rate, variability, periodic and nonperiodic changes, and contraction patterns.
- Describe the role, responsibilities, and accountability of professional obstetric nurses and healthcare providers relating to electronic fetal heart rate monitoring care.
- Describe appropriate nursing and collaborative interventions based upon the assessment of case presentations and fetal heart rate monitor tracings.
- Discuss required assessment, drug options, dose, and evaluation of pharmacotherapeutic agents and their impact on the maternal-fetal unit and/or neonate.

Planning Committee and Author/Speaker Declarations
The planners and presenters of this CNE activity have disclosed no relevant personal or financial relationships with any commercial interest pertaining to this activity. Director: James R. Woods, M.D. Planning Committee: Tamara Eis, M.S., R.N., Kathryn Flynn, R.N.C., M.S.N.P., Carol Giffi, R.N.C., M.S.N.P., J. Christopher Glantz, M.D., M.P.H., and Shirley Warren, R.N., M.S.N.P.-BC. Authors: Valerie K. Garrison and Katrina S. Korfmacher, Ph.D.

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Google Andriod Browser (1.6 or higher)
FlashPlayer (5.0 or later), QuickTime (6.3 or later), MediaPlayer (6.4 or later), or RealOnePlayer (2.0 or greater)
Adobe Acrobat Reader (5.1 or later)
Java VM 1.4 or later

MAC

MAC OS 10.2 or later
High-speed Internet connection recommended
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Obstetric and Fetal Monitoring Course

October 2014 Topic: Prenatal Care

Case #1108

Perinatal Environmental Health Focusing on Lead

Discussion, Clinical Case Study, and Fetal Heart Rate Interpretation

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Learning Objectives for **periFACTS®** Cases #1108 and #1109: **In addition to the overarching Obstetric and Fetal Monitoring Course objectives**, upon completion, the learner also will be able to:

- State the 2012 CDC reference blood lead level.
- List health impacts of perinatal exposure to lead.
- Summarize key messages to share with pregnant women about lead poisoning prevention.
- Interpret B.C.'s fetal heart rate tracing.

INTRODUCTION

Lead serves no useful purpose in the human body, but its presence can lead to toxic effects, regardless of exposure pathway. Until the mid to late 1970s, lead was commonly used in house paint and as an "anti-knock" agent in gasoline, when the United States (U.S.) government banned it from most residential paint and began phasing it out from gasoline. These policies dramatically reduced population exposure but did not eradicate it. Between 1997 and 2007, the number of children between

ages one and five in the U.S. with blood lead levels (BLL) greater than or equal to 10 µg/dL dropped from about 890,000 children to about 310,000 (ATSDR, 2007a). In 2012, the Centers for Disease Control and Prevention (CDC) estimated there still were 535,000 children with BLL over the new CDC reference value of 5 µg/dL (CDC, 2013). It should be noted that no organization, including the CDC, has established a "safe" low blood level, especially since lead accumulates in the body over time. Lead continues to affect many communities, especially low-income children living in older housing, at disturbingly high rates. Globally, the World Health Organization (WHO) has declared that the benefit of preventing childhood lead exposure is equal to or greater than that of vaccination for other diseases (WHO, 2010).

Thus, despite progress, elevated BLLs (EBLL) are still a significant health problem in the U.S. Additional sources of lead poisoning, such as imported or contaminated products, continue to be discovered each year. New research also shows that lead is more dangerous, both at lower levels and in more ways, than previously was understood. These recent findings have significant implications for women's healthcare providers. This article briefly reviews the current understanding of lead sources, exposure risks, and health impacts. It also highlights new findings that are particularly significant for perinatal care and reviews new clinical guidelines and counseling for addressing lead exposure during pregnancy.

LEAD 101

There are many excellent lead exposure and poisoning prevention materials for providers and patients, particularly related to protecting young children. Several national resources are listed in Figure 1; others may be available from local or state health departments that highlight particular issues of local concern and relevant policies, resources, and programs. A brief overview of the sources, effects, and guidelines for preventing lead poisoning is provided below.

Sources and Exposures

Lead is a naturally occurring metal that has been mined by humans for thousands of years and has been used in a wide range of products, resulting in its distribution throughout the environment. Before 1978, when lead was removed from residential paint, the main sources of lead poisoning were paint, house dust, contaminated soil, water, and some consumer products. House dust is the main route of exposure for most children today.

Adults who work with lead through a hobby or occupation (e.g., stained glass, target shooting, hunting, fishing, or soldering) may be at risk for poisoning. Lead exposure is a leading cause of workplace illness (OSHA, 2012). Workers involved in mining and smelting, mechanics, metalwork, plumbing, and construction (especially housing renovation, painting, and remodeling) are at particular risk of exposure.

Figure 1: Lead Poisoning Prevention and General Information Sources

National Toxicology Program: Health Effects of Low-Level Lead:
http://ntp.niehs.nih.gov/?objectid=4F04B8EA-B187-9EF2-9F9413C68E76458E

CDC: Lead Poisoning Prevention
http://www.cdc.gov/nceh/lead/

Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women
http://www.cdc.gov/nceh/lead/publications/LeadandPregnancy2010.pdf

ACOG: Lead Screening during Pregnancy and Lactation
www.acog.org/Resources_And_Publications/Committee_Opinions/Committee_on_Obstetric_Practice/Lead_Screening_During_Pregnancy_and_Lactation

NYSDOH Lead Poisoning Prevention Guidelines for Prenatal Care Providers
http://www.health.ny.gov/publications/2535.pdf (currently under revision)

The CDC (2010) recommends that occupationally exposed pregnant women be referred to an occupational physician for BLL monitoring and that steps be taken to minimize exposure if her BLL is greater than or equal to 5 µg/dL (CDC, 2010). For pregnant women with EBLL greater than or equal to 10 µg/dL, medical removal from the workplace is recommended.

Young children are exposed most commonly to high concentrations of lead through settled house dust and paint in older homes and through bare soil. Even if older homes have been repainted many times, friction surfaces like windows and doors or small areas of deteriorated paint may release contaminated lead dust. When homes are renovated, lead from old paint may be spread through the house and remain after workers leave. Bare soil also may be a hazard if it has been contaminated with old paint chips or emissions from leaded gasoline. Children are at particular risk of exposure if they get contaminated dust on their hands and accidentally ingest it; a small number of children, especially those with pica, may eat paint chips.

There have been recent concerns about lead exposure from water in some cities due to lead in old pipes and solder (Elfland, 2010, and Guidotti, 2007). Although drinking water rarely is a major source of poisoning, preventive measures sometimes are recommended. These include installing a filter, running water for five minutes before it is first used each day, and drinking or cooking with cold water only. Some household water filters are certified to remove lead when installed and maintained properly (NSF International, 2014).

In addition to housing-based hazards, some people may be exposed to lead through contaminated consumer products. Sometimes lead can be found in imported products like water hoses, jewelry, toys, ceramics, and traditional medicines and cosmetics; the

Consumer Product Safety Commission maintains a searchable database of recalled products (CPSC, 2014). It also has been found in food products such as candy and spices imported from countries such as China and other countries in the Far East.

Health Effects

Lead can adversely affect all systems of the body. However, there often are no signs or symptoms of lead exposure until harm has already been done, and these effects may be permanent. A blood test is the only way to tell if a person has been recently exposed. The CDC recommends blood testing for children at risk of exposure; some states, such as New York, require testing of all children at age one and again at age two (NYSDOH, 2011).

Children are affected at lower levels of exposure than are adults, and the effects may be lifelong. Lead damages children's developing brains, resulting in learning and behavioral difficulties (CDC, 2004; EPA, 2013; and NYSDOH, 2013). In addition, it is incorporated into soft tissues and bones as children grow, which can make children more susceptible to osteoporosis and other bone diseases as they age (Beier, 2013; Campbell, 2007; Carmouche, 2005; and Holz, 2007). Research has found that childhood exposure also contributes to hypertension and cognitive impairment in adulthood, and may manifest as lowered intelligence quotient or behavioral problems (Mason, 2014; Schwartz, 2007; Vaziri, 2008; and WHO, 2010).

Lead levels of concern for adults are set at higher levels than for children. Common symptoms of acute lead poisoning in adults include nausea, vomiting, fatigue, headache, and joint or muscle aches. Severe acute poisoning can result in coma or death. At lower levels, chronic exposure damages the hematopoietic, nervous, urinary, and reproductive systems (OSHA, 2014).

Because the health effects of lead poisoning are irreversible, it is imperative to provide education about ways to eliminate environmental hazards, as well as to offer screening to monitor exposure. Removing hazards helps prevent excessive lead exposure and can reduce its impact on those already exposed. When a source of exposure is removed, BLLs naturally decrease; in adults, the half-life of lead in blood is 28 to 36 days (ATSDR, 2007b). Lead also can accumulate in bones and body tissues and can be remobilized in the blood during pregnancy, lactation, and menopause, or after physical stresses to the body. Once deposited in bone, the half-life is 20 to 30 years, resulting in continuous toxicity (ATSDR, 2007b, and Liua, 2013).

Chelation therapy, which removes metals from the bloodstream, may be prescribed for children with extremely high BLLs (the CDC recommends chelation for BLL greater than or equal to 45 µg/dL) (CDC, 2012b). However, recent studies show that chelation has limited long-term benefits, indicating that exposure prevention is key (Brown, 2013; Dietrich, 2004; McKay, 2013; Rogan, 2001; and Sears, 2013).

Overview of Policies, Practices, and Public Health

Leaded house paint was banned from sale in the U.S. in 1978, although some companies began removing it from paint as early as the 1950s, and most other industrialized countries banned it in the 1920s. The U.S. Environmental Protection Agency (EPA) first announced regulations to limit leaded gasoline in 1976, but it was not fully phased out until 1996. Federal rules set standards for lead safety in federally assisted housing built before 1978 (HUD Lead Safe Housing Rule, 24 CFR Part 35).

Some states and cities have additional policies. Many states have "secondary prevention" programs that recommend or require testing children's blood for lead and following up with education or environmental investigations for EBLLs. Environmental investigations focus on identifying and reducing potential exposure hazards in children's lives, particularly in their homes or products they use. A small number of cities and states have primary prevention policies that require inspection and lead hazard reduction in privately owned housing (Korfmacher, 2013).

The U.S. EPA's Renovation, Repair, and Painting Rule (RRP), enacted in 2010, also helps protect children and families during renovation activities. This law requires that contractors performing painting, remodeling, or renovations that disturb more than a small amount of paint in homes built before 1978 be trained and certified according to RRP guidelines (EPA, 2014b).

Centers for Disease Control and Prevention Guidelines Revised in 2012

As scientific understanding of the negative impacts of even low levels of lead has grown, public health guidelines for lead poisoning have changed. Acknowledging that there is no safe lead level, the CDC issued a recommendation in April, 2012 eliminating the 10 µg/dL "level of concern" and replacing it with a lower "reference level" of 5 µg/dL. Children whose BLL exceeds this reference dose are considered to have an EBLL (CDC, 2012a).

Resources and programs exist to address EBLLs in children; these vary in different areas of the country. For example, public health professionals may provide education to parents about how to reduce exposures and recommend follow-up testing for children with EBLLs between 5 µg/dL and 10 µg/dL. At higher levels, they may visit the child's home for an "environmental investigation" to identify and require remediation of lead hazards. New York State is an example of a state that requires county health departments to do environmental investigations for children with BLL greater than or equal to 15 µg/dL, although several counties intervene at lower levels as resources allow.

LEAD IN PREGNANCY

Most programs for lead poisoning focus on children. However, there also are concerns for pregnant and lactating women. Adult women may have lead in their blood from

current or past exposures (e.g., from childhood exposure, consumer products, living in a country that still used leaded gasoline, or her occupation, all of which could result in elevated bone levels). Lead that is stored in a woman's bones or other tissues may be mobilized during pregnancy and lactation, re-entering her bloodstream where it can be transferred to the fetus through the placenta or to the infant through breast milk.

Prenatal exposure has lasting effects on the baby. As in young children, prenatal exposure can have a significant impact on neurodevelopment; effects have been shown across all trimesters (Hu, 2006, and Schnaas, 2006). Neurologic effects on the developing brain may result in symptoms such as attention deficit and hyperactivity (Plusquellec, 2007), lowered IQ (Schnaas, 2006), and a range of chronic illnesses later in life (Liua, 2013). Recent research in animals suggests that exposure combined with stress during pregnancy may have even greater effects on the baby than either one alone (Cory-Slechta, 2010; Cory-Slechta, 2008; and Virgolini, 2006). These findings highlight the importance of addressing these issues during pregnancy, especially in women at risk of exposure to both high levels of stress and lead (Rossi-George, 2009; and Virgolini, 2008).

Screening, Testing, and Counseling about Lead During Pregnancy

Alerting pregnant women to potential risks in their environment can help families reduce their baby's risk of exposure to high levels of lead during pregnancy or after birth. The American College of Obstetricians and Gynecologists (ACOG) and the CDC (Figure 1) both offer guidelines for counseling women about lead. The first step is to identify women who may be at risk, usually through screening questions about potential current or past exposures (Figure 2). Women who are or were potentially exposed are advised to get a blood test. If the mother's BLL is greater than or equal to 5 µg/dL, ACOG and CDC guidelines suggest educational counseling, follow-up testing, environmental/occupational investigations, or—for extremely high EBLLs of greater than or equal to 45 µg/dL—chelation. Unfortunately, there are no proven strategies for reducing exposure to the infant or fetus, although some studies in women with high BLL suggest that calcium supplementation may be helpful (Han, 2000, and Kosnett, 2007).

Counseling messages should be based on likely exposure sources. For example, refugees or recent immigrants may use traditional products known to contain lead and should be warned about these risks (NYSDOH, 2008). Mothers who may be exposed at work through such activities as glassmaking or soldering should talk to their employer about reducing exposure, wash hands frequently, and change clothes before returning home from work.

The most important message about lead for most pregnant women is reducing potential risks in the home. For women living in pre-1978 housing, an inspection or risk assessment from a private contractor or health department to identify sources and pathways of lead exposure is one option. If that cannot be done, it is safest to assume there is contaminated paint present in older homes. Because many families undertake renovations in preparation for a new baby, it is essential to make sure women are aware

of lead-safe renovation practices and, particularly, that they not increase their risk by doing renovation work themselves. The area being renovated should be tested before work begins to determine if lead paint or dust is present. A recent study found that 14% of investigations of children with elevated BLL in New York identified a source related to renovations (Franko, 2009). The 2012 USEPA Renovation, Repair and Painting (RRP) rule requires all contractors who work in pre-1978 homes to be trained, certified, and follow lead-safe practices (EPA, 2014b). It is especially important for pregnant women to avoid the property until renovation work and cleanup are complete.

Figure 2: What is My Lead Risk?

Excerpted from "Are You Pregnant? Learn how to Protect Yourself and Your Baby from Lead Poisoning" (NYSDOH, 2008)

If your patient answers "yes" to any of the following, consider conducting a blood lead test:

1. Do you live in a home or apartment built before 1978?
2. Have there been any recent home improvements or repairs where you live?
3. Were you born, or have you ever lived, in another country?
4. Do you use medicines, cosmetics, or spices from another country?
5. Do you, or someone with whom you live, have a job or hobby that could bring you into contact with lead?
6. Do you use pottery that was made in another country, painted china, or leaded glass?
7. Have you ever eaten or chewed crushed pottery, soil, paint chips, clay, or other things that aren't food?

A final message that should be communicated to all women, especially those with environmental lead risk factors, is the importance of having their children tested at age one and again at age two (Advisory Committee on Childhood Lead Poisoning Prevention, 2000). Some studies have suggested that testing babies with known risk factors at even earlier ages (e.g., six months) may help prevent future EBLLS (Binns, 2007), although this should not be substituted for testing at ages one and two, ages at which children are more mobile and likely to have higher BLL.

CONCLUSION

Lead is one of the oldest, most well-understood environmental health hazards, but over half-a-million children across the U.S. still have EBLLs. Risks are particularly high in low-income communities with older housing, but may exist in any area. New research underscores that pregnancy is a critical time to identify a woman's past and current

exposures. A history of past exposures may identify women who should be screened for future health problems including hypertension or osteoporosis. Current exposures can be addressed through residential hazard control, education, behavioral changes, elimination of lead-laden consumer products, or changes in the work place or living environment. Interventions with pregnant women have the added benefit of reducing the baby's future risk. As scientific understanding of lead continues to grow, so does our appreciation for the importance of reducing lead exposure for lifelong health.

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