Effects of Heavy Metal Poisoning during Pregnancy

Kapoor Neeti¹ and Tiwari Prakash²

¹Assistant Professor, Institute of Forensic Science, RTM Nagpur University, Nagpur, Maharashtra, INDIA
²Department of Criminology and Forensic Science, Dr. Hari Singh Gour University, Sagar, MP, INDIA

Abstract

Heavy metal and their salts are considered as very important group of environmental pollutant which in small quantities may be essential nutrients that protect your health, yet in larger quantity it becomes toxic and dangerous to human being. When you're pregnant you want to provide the best for your developing baby, starting with what you eat. Your diet, however, may include toxic metals that pose health risks to both you and your child. Heavy metals such as arsenic, mercury, lead and copper, cadmium are produced adverse effect during pregnancy which discuss below. This review paper provides an overview of the current knowledge of toxic effect of metal during pregnancy and to newly born baby. It will be helpful in causing awareness among the masses about the harmful effects of heavy metals and their detection.

Keywords: Heavy metal, arsenic, lead, copper, cadmium are produced adverse effect during pregnancy which discuss below.

Introduction

Heavy metals are defined as any metallic chemical element that has a high density and is poisonous at lower concentration. Heavy metals include arsenic, lead, copper and mercury which mainly affect reproductive system and especially toxic to growing fetus1. These heavy metals are not filtered by placenta from mother to child and are directly deposited in growing fetal tissue. Women under the influence of toxic metals may be infertile, wildly irregular hormone level. Their unborn children receive heavy metals from their pregnant mother. This review paper provide an overview of the current knowledge of toxic effect of metal during pregnancy and to newly born baby. The main objective is to encourage detoxifying mother before conception.

Arsenic: Arsenic is a grayish substance which is not poisonous, as it is insoluble in water which is not absorbed from alimentary canal. However, it is continuously changing into arsenious oxide or white arsenic which is tasteless and highly poisonous. Arsenic may be harmful during pregnancy. Exposure to arsenic in the diet may be harmful for pregnant women. Exposure to arsenic in the diet may be harmful for pregnant women. Exposure to arsenic in the diet may be harmful. The soluble compounds of arsenic are poisonous. Lead access into body through inhalation, by ingestion or by absorption through skin and mucous membrane2. When women encountered to lead during pregnancy can cause a miscarriage, premature birth Low birth weight and it affects development of fatuous brain and growth of new born baby also retarded. Lead poses health risks for everyone, but young children and unborn baby more prone to lead toxicity which contributes to affect development of growing children and their behavior and learning ability3.

Copper: Copper in metallic form is not poisonous but some of its salts are poisonous such as blue vitriol and sub acetate. Copper is a powerful inhibitor of enzyme. Sources of copper are common in the diet, particularly in vegetarian diets, and can be found in the water due to copper plumbing4. Many multiple vitamins contain relatively high doses of copper. The hormone estrogen promotes the retention of copper and this is why women are particularly vulnerable to the problem of copper toxicity. Copper toxicity may leads to poor fertility rate5.

Mercury: Mercury in metallic form refers as quick silver. Metallic form of mercury is not poisonous but when it is in vaporized form it is highly toxic. Elemental mercury and methyl mercury are two types of mercury that may increase health risks in pregnancy. Elemental mercury is found in dental fillings that can release small amounts of mercury vapor that can be inhaled, whereas methyl mercury is frequently found in natural water sources including waterways where fish swim. Toxicity from mercury may harm the developing nervous system of an unborn baby and cause learning disabilities and it effects reproductive
system and produces defects such as infertility, miscarriage and prematurity. Mercury lowers zinc levels, which can pass through both the placental barrier and the blood-brain barrier. Low libido (sex drive) and premenstrual syndrome (PMS) Lowered progesterone levels can lead to infertility. PMS and infertility are common among many young female dental workers due at least in part to their mercury exposure. Male dental workers also suffer from infertility. Mercury lowers zinc levels, which in turn leads to lower testosterone (male hormone) levels. Mercury transmitted to mother milk to child and affects their learning ability.

**Cadmium:** Scientists suspect that cadmium may pose a risk in pregnancy. One study suggests that cadmium may damage the placenta and reduce weight of newborn baby. This metal is used in many occupations, including semiconductor manufacturing, welding, soldering, ceramics and painting. Women who work with cadmium should take all recommended precautions and avoid bringing it home on clothing. Pregnant women also may want to consider eliminating sources of cadmium from the house, such as fungicides containing cadmium chloride, certain fabric dyes and ceramic and glass glazes and some fertilizers. Cadmium at lower concentration may produces adverse effect during delivery it causes abortion and weight of new born child will retarded.

**General Symptoms**

Heavy metal toxicity may be characterized by any of these symptoms: i. Chronic pain throughout the muscles and tendons or any soft tissues of the body, ii. Chronic malaise – general feeling of discomfort, fatigue, and illness, iii. Brain fog – state of forgetfulness and confusion, iv. Chronic infections such as Candida, v. Gastrointestinal complaints, such as diarrhea, constipation, bloating, gas, heartburn, and indigestion, vi. Food allergies vii. Dizziness, viii. Migraines and/or headaches, ix. Visual disturbances, x. Mood swings, depression, and/or anxiety, xi. Nervous system malfunctions – burning extremities, numbness, tingling, paralysis, and/or an electrifying feeling throughout the body.

**Note:** Heavy metal toxicity can produce vague symptoms that sometimes are mistaken for other chronic conditions such as Autism, Chronic Fatigue Syndrome, depression, Multiple Sclerosis, and a host of other serious disorders. Discuss heavy metal toxicity with your healthcare professional before receiving any diagnosis or treatment for a serious chronic condition.

**Effects of metallic poisons on newborn baby**

**Arsenic:** Effects muscular growth, low birth weight, mental growth retarded, low IQ level of newborn baby.

**Lead:** Adverse effect on neurodevelopment, brain growth is retarded, increases risk of miscarriage and increases changes of premature birth, effects IQ level of growing children. It decreases fetal growth.

**Copper:** Increases chances of miscarriage, complication during delivery, low birth weight, muscular weakness in newborn baby, it leads neurological problems in growing children.

**Mercury:** Effects mental growth of newborn baby, adverse effect on nervous system, effects cognitive thinking.

**Cadmium:** Effect growth of newborn baby, low IQ level, creates cardiac abnormalities. It produces craniofacial abnormalities such as eyes of newborn baby is small, nasal bridge is poorly formed, leads to renal abnormalities.

**Diagnosis**

The following tests and procedures may be helpful in diagnosing heavy metal toxicity and/or other chronic conditions:

- **DMPS provocation test** – A blood test that measures the amount of heavy metals being removed through the urine after a provoking agent (DMPS) has been used. The key to this test is that it does NOT show the amount of mercury and other heavy metals that are in the body; it only shows what is being removed. Therefore, this test must be taken numerous times over the course of the detoxification protocol. Once excretion levels begin to drop within normal ranges, this means that there is only a small amount of metals left to excrete. This is the best test for accurate measurement. For more information, contact your healthcare practitioner about DMPS.

- **Hair analysis:** A tablespoon of hair collected from the nape of the neck is analyzed for its mineral content. Hair holds a history of the past 3 months, but there is much speculation concerning the effectiveness of this type of testing and many believe that the test is useless.

- **Fecal testing and urine analysis:** Fecal testing and urine analysis reveal the effectiveness of chelation therapy in excreting heavy metals from the body. During chelation therapy, a chelating agent “provokes” excretion of heavy metals. These tests then measure the amounts of heavy metals that are being excreted during chelation therapy.

**Specific Heavy Metal Toxicity Testing**

**Urine Analysis:** A urine analysis is a series of tests that screens and evaluates the urine sample for abnormalities, presence of various compounds (protein, glucose, ketones), and to check for kidney and metabolic processes. The urinalysis also involves tests that assess the color, appearance, odor, and pH, and blood. A urinalysis is a part of routine medical examinations. It is especially done in patients who are pregnant, who are experiencing abdominal pains, blood in urine, frequent or painful urination, symptoms of dysuria, hematuria, diabetes, chronic renal failure, urinary tract infections, and other metabolic diseases.
There is no special diet or preparation before testing. However, taking some medications as some drugs can alter urinalysis results. Collection of urine sample during urinalysis is simple and will not cause any discomfort. This will only take a few minutes. There are no risks and side effects after this test.

### Table-1
Major metabolic factors associated with environmental pollutants such as lead, mercury, cadmium and arsenic.

<table>
<thead>
<tr>
<th></th>
<th>Lead</th>
<th>Mercury</th>
<th>Cadmium</th>
<th>Arsenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major route of entry</td>
<td>Ingestion and inhalation</td>
<td>Ingestion</td>
<td>Ingestion and inhalation</td>
<td>Ingestion</td>
</tr>
<tr>
<td>Gastrointestinal Absorption</td>
<td>~10</td>
<td>~95</td>
<td>~5</td>
<td>&gt;20</td>
</tr>
<tr>
<td>Organ of accumulation</td>
<td>Bone, kidney, liver</td>
<td>Brain, liver, kidney</td>
<td>Kidney, Liver</td>
<td>Keratinous tissue</td>
</tr>
<tr>
<td>Major route of excretion</td>
<td>Urine</td>
<td>Faces</td>
<td>urine</td>
<td>Urine</td>
</tr>
<tr>
<td>Biological half life</td>
<td>20yrs</td>
<td>70yrs</td>
<td>&gt;10yrs</td>
<td>10-30yrs</td>
</tr>
</tbody>
</table>

### Table-2
Interpretations of Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal level/range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance Color</td>
<td>Clear, Amber yellow</td>
<td>Cloudiness may indicate presence of pus, or bacteria. Red or brown urine indicates blood in the urine (bleeding from kidneys). Green may indicate infection.</td>
</tr>
<tr>
<td>Odor</td>
<td>Aromatic</td>
<td>Strong smell of acetone indicates diabetic ketoacidosis. Foul odor is indicates presence of UTI. Fecal odor indicates enterovesicle fistula.</td>
</tr>
<tr>
<td>pH</td>
<td>4.6-8.0</td>
<td>Abnormal pH may indicate kidney or urinary tract disorder. Increased levels indicate alkalemia, UTI. Decreased levels indicate academia, diabetes mellitus, COPD.</td>
</tr>
<tr>
<td>Protein</td>
<td>0-8 mg/dl, 50-80 mg/24 (at rest), &lt;250 mg/24 hr (during exercise)</td>
<td>Increased levels indicates renal disease, lupus erythematosus, heavy metal poisoning, CHF.</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.005-1.030</td>
<td>Low values indicate renal disease, over hydration, diabetes insipidus, diuresis. High levels indicate dehydration, diarrhea, decreased renal blood flow.</td>
</tr>
<tr>
<td>Leukocyte esterase</td>
<td>Negative</td>
<td>Detection of leukocyte esterase indicates possible urinary tract infection.</td>
</tr>
<tr>
<td>Nitrites</td>
<td>None</td>
<td>Detection of nitrites indicates possible urinary tract infection.</td>
</tr>
<tr>
<td>Ketones</td>
<td>None</td>
<td>Detection indicates anorexia, hyperthyroidism, diabetes mellitus, aspirin ingestion.</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>None</td>
<td>Detection indicates gallstones, liver metastasis, Rotor’s syndrome, tumor, inflammation.</td>
</tr>
<tr>
<td>Urobilinogen</td>
<td>0.01-1.0 Ehrlich units/ml</td>
<td>Increased levels indicate hemolytic anemia, pernicious anemia, hematoma, and ecchymosis. Decreased levels indicate cholestasis, biliary obstruction.</td>
</tr>
<tr>
<td>Crystals</td>
<td>None</td>
<td>Detection indicates renal stone formation, urinary tract infection.</td>
</tr>
<tr>
<td>Casts</td>
<td>None</td>
<td>Detection indicates UTI, pyelonephritis, acute tubular necrosis, chronic lead poisoning, mercury poisoning, heavy metal poisoning, eclampsia, CHF.</td>
</tr>
<tr>
<td>Glucose</td>
<td>None</td>
<td>Detection and increased level of glucose indicates kidney damage, diabetes, pregnancy.</td>
</tr>
<tr>
<td>WBC</td>
<td>0-4 per low power field</td>
<td>Increased WBC indicates bacterial infection.</td>
</tr>
<tr>
<td>RBC</td>
<td>≤ 2</td>
<td>Increased RBC indicates primary renal disease, cystitis, prostatitis, bladder trauma.</td>
</tr>
<tr>
<td>RBC casts</td>
<td>None</td>
<td>Increased RBC cast indicates systemic lupus erythematosus, vasculitis, subacute bacterial endocarditis.</td>
</tr>
</tbody>
</table>
Factors such as prolonged refrigeration, presence of sperm in the urethra, consumption of foods such as carrots and beets and some drugs can affect the appearance and odor of the urine sample. Vaginal discharge can contaminate the urine sample and alter the results.

**Urine Element Testing:** For diagnosis of the presence of certain toxic element burdens, post provocation testing is recommended. This involves urine collection following oral or intravenous administration of chelating or complexing agents that mobilize elements from otherwise slowly exchanging tissue pools. For example, non-provoked levels of cadmium, mercury, and lead may not be indicative of deep tissue stores and only reflect ongoing or very recent exposure.

Unprovoked urinary levels of essential elements such as magnesium, calcium, sodium, and potassium may be indicative of renal wasting conditions and provide early warning of renal dysfunction. Magnesium loading tests can also be performed using urine elements testing. Provoked urinary levels of elements that chelation agents have an affinity for can provide valuable information as to the efficacy of the provocation. Blood levels are better indicators of nutritional element status.

Analysis of elements in urine provides diagnostic information on potentially toxic elements such as lead, mercury, cadmium, nickel, beryllium, arsenic and aluminum, and assessment of the efficiency of renal re-absorption of essential elements such as magnesium, calcium, sodium and potassium. Urine element analysis is an invaluable tool for the diagnosis or confirmation of toxic element burden and monitoring of detoxification therapy.

The chelating agents (captomer) may be administered orally to provoke urinary levels of elements. Administration of chelating agents will only last for a few minutes. However, collection of the urine sample will be done over the next six to 24 hours depending on your physician’s recommendations. This test will be painless and simple. Normally, there will be no side effects after the test.

Contamination during urine sample collection may alter the results for heavy metals. Specimen should immediately be transported to the laboratory for accuracy or refrigerated if it
cannot be processed right away. Positive results for heavy metal test must be confirmed by repeating the procedure.

**Detoxification of body:** Detoxification means removal of metal toxicity from body, it is important for a lady to detoxifying their body before conception. The average time for detoxification depend upon the concentration of metal toxicity and efficiency of detoxifying organs. It is advisable to adopt healthy life style. Consume organic food and all organs which responsible for excretion must be opened for detoxification.

**Treatment: Chelation therapy:** Chelation therapy is a treatment procedure used to treat heavy metal poisoning. This therapy involves injection of ethylene diamine tetra acetie acid (EDTA), a chemical that binds, or chelate, heavy metals, including, lead, mercury, cadmium, and arsenic. The term "chelation" comes from the Greek word ‘chele’, which means "claw," referring to the way the chemical grabs onto metals chelation therapy using EDTA has been approved by the U.S. Food and Drug Administration (FDA). The human body cannot break down heavy metals, which can build up to toxic levels in the body and interfere with normal functioning. EDTA and other chelating drugs lower the blood levels of metals attaching to the heavy metal molecules, which helps the body remove them through urination. EDTA can reduce the amount of calcium in the bloodstream, so help to reopen arteries blocked by mineral deposits, a condition called atherosclerosis or hardening of the arteries. They claim it is an effective and less expensive alternative to coronary bypass surgery, angioplasty, and other techniques designed to unblock arteries.

**Conclusion**

Above described are some of the heavy metals which are poisonous in nature specifically harmful for the women who are pregnant and the baby whom they are carrying in their womb. Heavy metals such as arsenic, lead, copper and mercury effect reproductive system and the baby whom they are carrying in their womb. Heavy metals such as arsenic, lead, copper and mercury etc by pregnant women is genuinely a serious problem. Therefore care must be taken by the individual to avoid consuming such substances which may lead to further complications in their pregnancy and abnormalities in newly born infants.

**References**

11. Heavy Metal Analysis and Interim Recommended Limits for Botanical Dietary Supplements, White Paper, the American Herbal Products Association.