Impact of heavy metals on pregnancy – A pilot investigation

Patil V.N.
Shinde M.A.
Bagul D.B.
Dinesh Kumar B.

www.ijmch.org

what is the impact of environmental pollution with heavy metals like lead and cadmium on pregnant women?
Impact of heavy metals on pregnancy – A pilot investigation

Patil V.N.*, Shinde M.A.**, Bagul D.B.***, Dinesh Kumar B.#

*Assistant professor, ** Professor & HOD, *** Registrar, Dept. of Obst. & Gynec., Dr.V.M. Govt. Medical College, Solapur, Maharashtra, # Scientist E, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad (AP).

Correspondence : Dr. Patil Varsha N.
E-mail. : varshup16@yahoo.com

Abstract

Research Question : what is the impact of environmental pollution with heavy metals like lead and cadmium on pregnant women ?

Setting : Tertiary Govt. Hospital at Solapur, Maharashtra.

Study design : Hospital based cross sectional community based study.

Participants : Thirty women admitted in antenatal ward of Dr. V.M. Govt. Medical College and Hospital, Solapur with pregnancy related complications.

Materials and methods : 5 ml of venous blood sample of 30 pregnant women were taken. Blood lead (Pb), Cadmium (Cd) and haemoglobin (Hb) levels were estimated.

Results : High Blood Lead Levels (> 10 μg / dl) were observed in 83.3% of women. All women had cadmium (Cd) within permissible limits (< 10 μg /L). High incidence of anemia was observed. Blood lead levels correlated inversely with severity of anemia.

Key words : Pregnancy, Lead, Cadmium, Anemia.
INTRODUCTION: -

The main threats to human health from heavy metals are associated with exposure to lead & cadmium. The important sources of lead exposure include gasoline additives, lead based paints, Ceramic Glazes, drinking water systems, cosmetic and folk remedies, and battery / plastic recycling industry. Lead is absorbed by ingestion, inhalation and through skin. Lead passes through the placenta easily and fetal blood has almost the same lead concentration as maternal blood. (Lauyers R, et al 1978.) Pregnant women and children are the most vulnerable groups when exposed to heavy metals.

Sub clinical toxicity due to chronic low levels of lead exposure have adverse effect on maternal and fetal outcomes at current acceptable levels ($\leq 10 \mu g/dl$) (Mohsen Vige et al, 2010 and Awasthi et al 1996.) Among the classical manifestation of lead intoxication are anemia, gastrointestinal, renal and nervous symptoms (Gerber G.B. 1980.) Low to moderate lead exposure may increase the risk of spontaneous abortions (Victor H. Borja - Aburto 1999). The possibility of a link between lead and cadmium pollution and still births has been suggested. The risk of premature rupture of membrane and preterm labour is also seen. (Torres – Sanchez et al 1999). Relatively low blood lead levels ($\geq 10 \mu g/dl$), have now been shown to be associated with abnormalities in haemopoietic, nervous, and renal systems. (Kumar and Krishnaswamy 1995). Other pregnancy complications like anemia, pregnancy hypertention, toxaemia are higher in women with higher blood lead levels (Kaul et al 2002).

Cadmium is another heavy metal used in battery industry. Cigarette / Bidi making and smoking is a major source of cadmium exposure. Cadmium is transferred in part to child through breast milk after birth. (Nishijo M et al 2001).

Susceptibility to lead toxicity is known to be influenced by a number of physiological and environmental factors, particularly age, diet and metabolic effects (Lavender 1979, Krishnaswamy and Dinesh Kumar 1998.)

It has been reported that a low calcium diet results in increased susceptibility to lead toxicity by increase in blood and tissue lead concentration during pregnancy. (Ballew and Bowman 2001; Ettinger et al 2007.)

Further lead toxicity is often associated with anemia and increase lead absorption has been reported during iron deficiency anemia. (Morrion and Quarterman 1987, Goddard et al 1997, Jain et al 2005; Muwakkit et al 2008.)

Therefore the objective of the study is to assess the levels of lead and cadmium in blood and correlation with iron deficiencies in pregnant women.

These results are expected to help in formulating diet - based therapeutic strategies against chronic lead and cadmium toxicity.

Given this background, a study was carried out with an aim to study lead and cadmium levels among pregnant women and their nutritional status.
METHODS

Study Design
A cross sectional community based study was carried out among pregnant women of lower socio-economic status admitted in Antenatal Ward in city of Western India.

Study location
The study was carried out in the city of Solapur in Maharashtra. The city was chosen because it is known for textile industry where textile dyes are used also it is engaging women of lower socio-economic status in Bidi making where exposure to tobacco by skin contact is very high. It was a pilot study of 30 patients.

Selection of Subject:
30 women admitted in antenatal ward of Dr.V.M. Govt. medical college, Solapur were selected. All women had some pregnancy related complication like anemia / PIH/theretened preterm labour, IUGR, etc.

The written informed consent from the women was obtained.

Patients history, socio-economic status, occupation, examination findings and relevant information was recorded in the prescribed proforma.

SAMPLE COLLECTION AND LABORATORY INVESTIGATION

About 10ml blood was collected from all the women by veni-puncture into vaccutainer tubes. Hemoglobin was estimated by Sahli’s method in all samples.

MEASUREMENT OF BLOOD LEAD AND CADMIUM LEVELS:

After collection 100 microliter of venous blood was transferred to meta exchange tubes and analyzed with Blood Lead Analyzer. Also blood cadmium levels were analyzed. (Courtesy : National Institute Of Nutrition, ICMR, Hyderabad)

RESULTS:

• Anthropometry and clinical profile.
  o Of all the women studied, mean height was 144cm, weight 42kg and BMI was 22.4 kg/m².

• Table No.1: correlation between anemia and blood levels

<table>
<thead>
<tr>
<th>Hemoglobin (Hb)</th>
<th>No. of patient</th>
<th>Normal lead level (Pb)</th>
<th>Increased lead level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 7 gm%</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7.1-9 gm%</td>
<td>9</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>9.1 - 11 gm%</td>
<td>15</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>&gt; 11 gm%</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

The incidence of anemia in our study group was 83.3%. Out of 30 patients, 3 patients were found to have sever anemia, 9 had moderate anemia and 15 patients had mild anemia. The severity of anemia also coincides with high levels of lead in these patients.
Table No.2 : Severity of lead toxicity

<table>
<thead>
<tr>
<th>Lead (Pb) levels</th>
<th>Number of patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>5</td>
</tr>
<tr>
<td>10-20</td>
<td>16</td>
</tr>
<tr>
<td>21-40</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>4</td>
</tr>
</tbody>
</table>

The percentage of women with high lead levels is 83%. 4 patients had very high blood lead levels (> 40 μg / dl). All the patients in the study had cadmium levels < 10 μg / l, which is within permissible limits.

Table No.3 : Pregnancy complications.

<table>
<thead>
<tr>
<th>Pregnancy complication</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension BP &gt; 140 / 90 mmHg</td>
<td>8</td>
</tr>
<tr>
<td>Spontaneous abortion</td>
<td>1</td>
</tr>
<tr>
<td>Intra uterine growth retardation</td>
<td>9</td>
</tr>
<tr>
<td>Threatened preterm labour</td>
<td>2</td>
</tr>
<tr>
<td>Adverse perinatal outcome</td>
<td>4</td>
</tr>
</tbody>
</table>

In our study 8 patients were found to have pregnancy induced hypertension. Toxic blood lead levels were also observed in these patients. One patient had spontaneous abortion. Intrauterine growth retardation with oligohydramnios was seen in 9 patients. 2 patients were admitted for threatened preterm labour. Of these patients 4 patients who delivered within the period of our study had adverse perinatal outcome i.e. 1 patient had early neonatal death after 5 hours of birth. 3 patients had low birth weight babies who needed NICU care.

DISCUSSION

Accumulating evidence suggests that nutritional status interacts with environmental pollutants and thus modulates susceptibility to toxicity. Lead and cadmium are heavy metals that have no established biological functions. Studies over the past two decades suggest that chronic low level exposure to leads to increased blood and tissue lead concentrations and is associated with abnormalities in several tissues functions, especially in haemopoietic, renal, reproductive and nervous systems (Preuss 1993; Papanikolaou et al 2005; Toscano and Guilarte 2005). Further human studies have demonstrated an association of Fe status with blood lead levels and toxicity. (Goddard et al 1997; Ros and Mwanri 2003; Jain et al 2005; Muwakkit et al 2008).

It is known that iron deficiency characterized by low hemoglobin and serum Fe levels lead to increased lead absorption, which could be mediated through Divalent metal iron transporter –I at the muscosal surface (Bressler et al 2004).

In the study we observed high lead levels (> 10μg/dl) in 83.3% of pregnant women. Prevalence of anemia is common in Indian women due to high intake to vegetarian diets rich in phytic acid. Pregnancy also contribute to anemia due to hemodilution. Also calcium requirement in pregnancy is increased. A strong protective effect of calcium supplement and high dietary calcium intake has been proven. Studies have shown that absorption of
lead by gastrointestinal tract is inversely related to calcium contents of diet. It is important to realize that improving nutritional status of women before pregnancy and correction of anemia and other micronutrient deficiencies will reduce effects of environmental pollutants like lead and cadmium.

Many studies have explored the association between higher blood lead levels and pregnancy hypertension. Magri et al (2003) found that with 33 women gestational hypertension had significantly higher mean blood lead level than women who did not. Similar results were seen in our study.

CONCLUSION

Ours is the limited study but clinical evaluation and high lead levels herein suggest high prevalence of lead toxicity defined by blood lead levels > 10 μg/dl in our city. Also anemia and other nutritional deficiency is commonly seen. Iron, calcium and micronutrients supplementation during pregnancy might help in preventing toxicity of heavy metals. Further studies in this field should be taken up by researchers to prevent adverse effects of heavy metals on women and children.

REFERENCES

7. Ettinger As, Hu H, : Cascas SB Sordo Editors lead chemistry analytical aspects environmental impacts and health effects Netherlands elsvier publication P 158-228.
10. Gulson BL Mahaffey et al 1999 impact of diet on lead in blood and urine in female adults and relevance to mobilization of lead from bone stores environ health perspect 107:257-263.
16. Levander OA 1979 lead toxicity and nutritional deficiencies environ health perspect 29:115-125.