Environmental lead contamination in relation to semen quality

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Abstract:

Background

Semen quality is a measure of the ability of semen to accomplish fertilization. Semen quality involves both sperm quantity and quality. The general population is exposed to metals at low concentrations either voluntarily through supplementation or involuntarily through intake of contaminated food and water or contact with contaminated soil, dust, or air. Some metals, such as lead (Pb), are nonessential xenobiotics that can be measured in most of the general population.

Objectives

Our goal in this study is to assess relationships between exposure to lead at environmental levels and human semen-quality parameters.

Materials and Methods:

The study populations consist of 81 infertile male of general population who are occupationally unexposed to lead and another 26 healthy fertile male as control group.
Blood lead and seminal plasma lead measurements performed by the electrothermal-atomic absorption spectrometry (AAS) method. Macroscopic and microscopic examination of semen performed according to WHO recommendations. Seminal plasma separated from the spermatozoa by centrifugation and stored at -20°C until required for analyses.

Results

This study showed significant increase in seminal plasma lead mean value in moderate and severe oligozoospermic infertile males than in fertile male controls($p<0.05$). The result also showed no statistically significant difference in blood lead concentration among the infertile group compared to fertile controls.

Conclusions

The results of this study indicate that even moderate exposure to Pb at environmental level (blood Pb < 400 µg/L) can significantly reduce reproductive capacity in men.

Key Words : Infertility, Lead, Semen quality.

Introduction

Infertility has often been defined as failure to achieve pregnancy within one year of unprotected intercourse. Reproductive function has been shown to be sensitive to changes in the physical, psychosocial and chemical environments. Reproductive effects of occupational exposure to hazardous chemicals have been well documented in the literature, although increased environmental chemical pollution has been implicated in poor sperm quality(1). The general population is exposed to metals at low concentrations either voluntarily through supplementation or involuntarily through intake of contaminated food and water or contact with contaminated

soil, dust, or air. Some metals, such as lead (pb), are nonessential xenobiotics that can be measured in most of the general population (2).Lead is pervasive in the human environment and accumulates in the human body over a lifetime, including prenatal life. Apart from numerous sources of occupational exposure to lead, the most important non occupational sources are food (especially seafood from metal-polluted areas), water (mostly from Pb pipes in contact with soft and acidic water), air (especially Pb from gasoline and other petroleum products) and Pb-based paints of housing(3). Because widespread human exposure and body burden have been demonstrated, there is growing concern for adverse health effects associated with low-level exposures encountered in the environment. Human and animal evidence suggests that these metals may have adverse impacts on male reproductive health at relatively low levels. Pb may adversely affect sperm morphology, motility, and DNA integrity (4).We designed the present study to explore relationships between lead and semen quality among men with exposure levels that are likely to be representative of those found among the general population. As compared to other countries, our general population has relatively higher exposure to Pb because of the prevalent use of petroleum products, containing Pb as fuel in electricity generators (0.5-0.8 g Pb/L gasoline). Our goal in this study is to assess relationships between exposure to lead at environmental levels and human semen-quality

3-Materials and Methods

The study population consist of 81 infertile male of general population who are occupationally unexposed to lead and another 26 healthy fertile male as control group.
.The selection criteria will be:
-Absence of a disease condition.
-Absence of exposure to physical and/or chemical factors that affect or are suspected to affect spermatogenesis or semen quality.
-Absence of acute disease, or high body temperature during the preceding 4 months (period that exceeds the duration of one spermatogenesis cycle of approximately 72 ±9 days).
- None of the selected subjects had ever received any chelating therapy or used any medication that could influence metal metabolism. A detailed questionnaire were taken for the subjects about personal history, physical examination done for final selection of subjects, Subjects with any of the following findings were excluded: varicocele, cryptorchidism, hypogonadism, indication of chronic orchoepididymitis, or history of genital region trauma. Special care was taken to ensure identical conditions for each of the selected subjects with regard to semen and blood sampling, storage, and analysis. Five ml of venous blood was sampled into a EDTA-containing tube which can be kept in the refrigerator up to one month for blood Pb(BPb) analyses . Blood lead measurements performed by the electrothermal-atomic absorption spectrometry (AAS) method(5). Semen sample will be collected by masturbation into sterile Petredish under clean condition after a period of abstinence of 3-4 days. Macroscopic and microscopic examination of semen performed according to WHO recommendations (6).Seminal plasma separated from the spermatozoa by centrifugation and stored at -20°C until required for analyses. The seminal fluid concentration of Pb measured by (AAS) method (5)

Results

Blood Lead:

The results of blood Pb concentration determination in different infertile groups revealed that there was no statistically significant differences (P>0.05) between the groups compared to control group as shown in tables (1, 2) and figures (1a, 1b).

Seminal Lead :

As shown in table (1) and figure (1a) fertile group had lower seminal Pb compared to sperm concentration categories of infertile group. The mean seminal Pb was highest among those with moderate and sever oligozoo spermia (8 and 7.5) µg/dl respectively.
The difference in mean was statistically significant (P<0.05).No statistically significant difference in mean (P>0.05) was found for the seminal Pb concentration between fertile group compared to categories of infertile group based on sperm motility and morphology table (2) figure (1b).

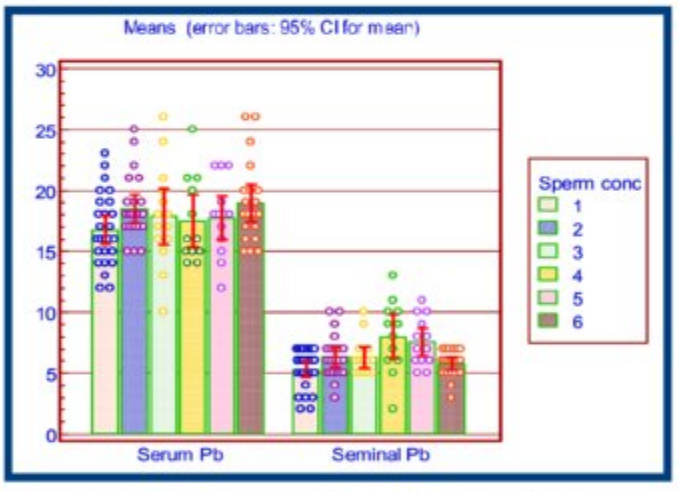

Figure: 1a Dot diagram with error bars showing the mean (with it's 95% confidence interval) of blood and seminal Pb concentration by different sperm concentration classes.
1-Control group
2-Infertile with normozoospermia
3-Mild oligozoospermia
4-Moderately sever oligozoospermia
5-Sever oligozoospermia
6-Azoospermia

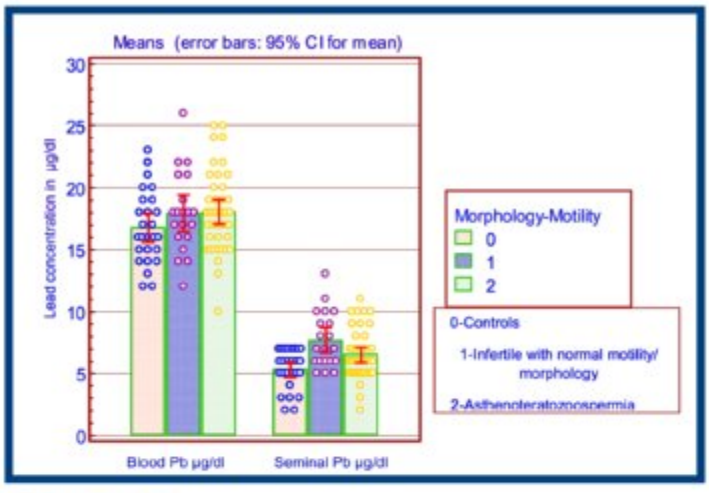

Figure: 1b Dot diagram with error bars showing the mean (with it's 95% confidence interval) of blood and seminal Pb concentration by different sperm morphology/motility classes.

Table 1: Blood and seminal concentration of Pb in infertile cases at different sperm concentration anomalies compared to control.

	Controls (fertile) with normozoospermia	Infertile with normozoospermia	* Mild oligozoospermia	**Moderately severe oligozoospermia	*** Severe oligozoospermia	Azoospermia	P
Seminal Pb µg/dl							**0.009**
Range	(2 - 7)	(3 - 10)	(5 - 10)	(2 - 13)	(5 - 11)	(3 - 7)	
Mean	5.3	6.3	6.3	8	7.5	5.8	
SD	1.6	1.8	1.5	3	2	1.1	
SE	0.32	0.38	0.41	0.86	0.55	0.25	
N	26	22	14	12	13	20	
Blood Pb µg/dl							**0.26[NS]**
Range	(12 - 23)	(15 - 25)	(10 - 26)	(14 - 25)	(12 - 22)	(15 - 26)	
Mean	16.8	18.5	17.9	17.5	17.8	19	
SD	2.9	2.6	4.1	3.5	3.1	3.3	
SE	0.57	0.56	1.1	1.01	0.86	0.75	
N	26	22	14	12	13	20	

* (10-20 million/ml), ** (5-10 million/ml), ***(less than 5 million/ml) Fauser et al.,

Table 2: Blood and seminal concentration of Pb in infertile cases with normal sperm (motility/ morphology), asthenoteratozoospermia compared to controls.

	Controls (fertile) with normal motility	Infertile with normal motility/ morphology	Asthenoteratozoospermia	P
Seminal Pb µg/dl				**0.06[NS]**
Range	(2 - 7)	(5 - 13)	(2 – 11)	
Mean	5.3	7.7	6.5	
SD	1.6	2.3	2	
SE	0.32	0.5	0.31	
N	26	20	41	
Blood Pb µg/dl				**0.88[NS**
Range	(12 - 23)	(12 - 26)	(10 - 25)	
Mean	16.8	18	18	
SD	2.9	3.3	3.3	
SE	0.57	0.73	0.51	
N	26	20	41	

workmen occupationally exposed to lead. Arch Environ Health. 1975;30:396-401.

5-Discussion:

The results of this study indicate that seminal Pb concentration was higher among infertile patients than the fertile controls in spite that the (BPb) concentration was comparable in all groups. Which may be explained by the fact that blood Pb mainly reflect current or recent exposure to the metal, whereas seminal fluid Pb appear to better reflect long-term cumulative exposure to the metal (8,9). Seminal plasma Pb concentration may provide better assessment than BPb of the amount of accumulated Pb at the site of its effect in the reproductive system. The observed Pb-related effects on semen quality (a decrease in sperm density and sperm count) have also been indicated, to a certain extent, in the studies of other authors (10-15). In most of these studies, significant alterations of reproductive parameters were observed at relatively higher BPb levels (> 400 µg/L), The overall results of this study indicate that even moderate exposure to Pb (BPb < 400 µg/L) can significantly reduce human semen quality. The observed Pb-related effect on semen quality was in accordance with other authors (14, 16,17). It is probably due to the direct toxic effect of Pb on germinal epithelium of testis during spermatogenesis. Long-term Pb exposure (independent of current Pb exposure levels) may diminish sperm concentrations, total sperm counts, and total sperm motility (9).In contrast, in most of other studies the significant alterations of semen parameters were observed at relatively higher BPb levels (> 40 µg/dl). With regard to the WHO-proposed no-adverse-effect levels of BPb in adult male subjects (18), the results of this study indicate that even moderate exposure to Pb at environmental level (BPb < 400 µg/L) can significantly reduce reproductive capacity in men.

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