

EFFECT OF SMOKING ON BLOOD AND SEMEN LEAD LEVEL IN MALE PARTNERS OF INFERTILE COUPLE

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Abstract

Cigarette smoking is a source of environmental airborne lead exposure. Lead exposure is known to be harmful to the male reproductive system. The study was done to find out the effect of smoking on the lead level in blood and semen of our infertile males and to find its effect on the semen parameter. The study was cross-sectional in design. The study population consisted of male partner of 57 consecutive infertile couple attending a tertiary infertility center in Bangladesh. 50% of the men were found to be smoker. 82.7% of the patients with smoking habits was less than 40 years. 20.7 % of the men smoke more than 10 sticks per day. 10.7% of nonsmokers and 27.6% of the smokers suffered from secondary infertility. The mean blood lead level among smokers and nonsmokers was 17.64 ± 9.04 and 23.88 ± 17.10 respectively. The mean semen lead level among smokers and nonsmokers was 38.59 ± 30.08 and 35.35 ± 48.87 respectively.

Key words : blood lead levels; semen lead level; smoking in infertile patient

Introduction

Despite the anti-smoking campaigns cigarette smoking is quite common. In a meta-analysis a negative association was found between cigarette smoking and semen quality¹. Numerous studies have shown that 15 to 30% of lead (Pb B) exposure for the general population comes from inhalation and 70 to

85% from ingestion². Cigarette smoking or secondary exposure to cigarette smoke can result in an elevation of blood-lead levels. Recent studies shows that adverse effects such as lowered sperm counts, and increases in the numbers of abnormal sperm may be associated with Pb B concentrations below the currently accepted worker protection criteria of 40 g/dL^{3,4,5}. Oldereid et al in 1994 found seminal plasma lead level to be unaffected by smoking status⁶. Tobacco smoke reduces both male and female fertility. Cigarette smoking has detrimental effect on semen parameters and Telisman in his study found blood lead to be higher in smokers⁷. Vine et al, in a meta-analysis of studies published between 1981 and 1992, showed that smokers' sperm concentration was on average about 15% lower than that of non-smokers⁸.

Lead interferes with biochemical processes occurring in cells throughout the body. There is no safe level in blood. More than 10 µgm/ml in children and more than 25 µg/dl in adults may cause toxic manifestations. About 40-50% of infertility is totally or in part due to male factor and about 10-20% due to unexplained infertility. So a search for some undetermined factor may be an important finding as a preventive factor for infertility. Benoff et al. in 2003 analysed lead in seminal plasma as a biomarker to predict IVF success and found a significant negative relationship between semen lead levels and fertilization rate in IVF⁹.

According to National Institute for Occupational safety and health (1994) protocol, lead level more than 40.0 µgm/dl require medical intervention. In Bangladesh no work has been done on the lead status of the infertile patients. The study was done to find out the level of lead in blood and semen samples of infertile male patients among smokers and nonsmokers and to find the effect of smoking on semen parameters in patients attending a tertiary infertility center in Dhaka, Bangladesh. As Bangladesh is a developing country with poor economic resources and infertility treatment is expensive, preventable factors of infertility can be a cost effective intervention for male infertility.

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Material and methods

The study is cross-sectional in design. Male partner of 57 consecutive infertile couple attending a tertiary infertility center was included in the study. Informed consent was taken from the patient regarding the participation of the study. Participants filled a questionnaire themselves. Of the 57 patients taken into the study 29 were smokers and 28 was nonsmokers.

Venous blood from anti-cubital vein was collected into pre-treated metal free plastic test-tube with anticoagulant (EDTA) for blood lead measurement. Metal free container for semen collection for semen analysis and lead assessment was provided to the patient. Semen analysis was done and semen sample for lead assessment was centrifuged for 15 minutes and the supernatant of seminal fluid was taken into cryotube and preserved at -70° centigrade until analyses. Whole blood with anticoagulant was preserved at -35° centigrade.

Analytic procedure : The lead measurement of the blood and semen was done by the graphite furnace atomic absorption spectrophotometer. Macroscopic and microscopic examination of the semen was performed according to the WHO recommendation using Makler Chamber (WHO 1999).

Results

50% of the men were found to be smoker. 20.7 % of the men smoke more than 10 sticks per day and 79.3% upto 10 sticks per day. 53.5% of the males in

the nonsmoker group was less than 40 years of age where as 82.7% of the patients with smoking habits was less than 40 years. 46.4% of the patients in the nonsmoker group and 55% of the patients in the smoking group suffered from infertility for 5 years and less. 10.7% of nonsmokers and 27.6% of the smokers suffered from secondary infertility. The mean blood lead concentration was 17.64± 9.04 in the infertile men with smoking habit and 23.88 ±17.10 µg/dl in infertile nonsmokers. The mean semen lead level among smokers and nonsmokers was 38.59 ±30.08 and 35.35 ±48.87 µg/dl respectively.

Infertile men with smoking habit did not show any significant difference in their blood and semen lead levels depending on sticks of cigarettes they smoked per day. Mean blood lead level in infertile men smoking ≤10 (n=23) and >10 (n=6) sticks per day were 17.03±9.19 and 19.75±8.90 µg/dl, and semen lead levels were 38.44±32.64 and 39.19±19.44 µg/dl, respectively (Table I).

Table I : Effect of smoking on blood and semen lead level

Smoking habit (sticks per day)	n	Blood lead level (µg/dl)	Semen lead level (µg/dl)	P value
		(Mean±SD)	(Mean±SD)	
≤10	23	17.03±9.19	38.44±32.64	>0.50ns
>10	6	19.75±8.90	39.18±19.44	>0.50ns

Unpaired student's 't' test, ns = Not significant

Table-II : Effect of smoking on semen: parameters of different blood lead cutoff values

Parameters	≤25	>25	≤30	>30	≤35	>35
Nonsmoker	n=16	n=12	n=20	n=8	n=23	n=5
Smoker	n=24	n=5	n=25	n=4	n=27	n=2
Blood lead (µg/dl)						
Nonsmoker	12.66±7.00	38.83±14.96	15.53±8.58	44.75±15.21	17.75±9.90	52.04±15.08
Smoker	14.53±6.24	32.56±3.38	15.05±6.64	33.81±2.19	16.33±7.88	35.33±0.18
P value	>0.10ns	>0.10ns	>0.50ns	>0.10ns	>0.50ns	>0.10ns
Semen lead (µg/dl)						
Nonsmoker	25.76±8.33	48.14±73.86	25.67±9.69	59.54±89.56	25.69±11.14	9.80±111.49
Smoker	39.89±32.48	32.37±14.44	39.56±31.84	32.54±16.67	38.73±30.99	36.75±18.95
P value	>0.05ns	>0.50ns	>0.05ns	>0.10ns	>0.05ns	>0.50ns
Semen volume (ml)						
Nonsmoker	2.59±1.35	2.63±1.07	2.72±1.32	2.31±0.88	2.65±1.28	2.40±0.89
Smoker	2.21±1.33	3.20±1.79	2.24±1.32	3.25±2.06	2.22±1.30	4.50±2.12
P value	>0.10ns	>0.10ns	>0.10ns	>0.10ns	>0.10ns	0.05ns

Blood lead cutoff values (µg/dl) (Mean±SD)

Semen TC (million/ml)						
Nonsmoker	30.94±39.25	41.67±36.81	31.40±36.13	45.88±42.75	39.48±39.93	17.40±20.70
Smoker	53.67±44.38	25.40±31.70	51.92±44.32	30.50±35.04	49.82±43.82	45.00±49.50
P value	>0.10ns	>0.10ns	>0.10ns	>0.50ns	>0.10ns	>0.10ns
Semen motility (%)						
Nonsmoker	46.88±24.69	53.33±22.70	46.50±23.00	57.50±24.93	50.43±23.83	46.00±25.10
Smoker	57.92±31.92	62.00±25.88	56.80±31.59	70.00±21.60	58.14±30.76	65.00±35.36
P value	>0.10ns	>0.10ns	>0.10ns	>0.10ns	>0.10ns	>0.10ns
Semen rapid linearity (%)						
Nonsmoker	28.44±24.41	32.92±20.72	28.25±22.73	35.63±22.90	31.52±23.28	25.00±20.62
Smoker	45.42±30.68	42.00±31.14	44.00±30.86	50.00±29.44	44.07±30.45	55.00±35.36
P value	>0.05ns	>0.10ns	>0.05ns	>0.10ns	>0.10ns	>0.10ns
Semen morphology (%)						
Nonsmoker	36.88±16.21	37.50±8.66	36.00±15.01	40.00±7.56	36.96±14.28	38.00±8.37
Smoker	38.54±17.16	32.00±13.04	37.80±17.20	35.00±12.91	37.22±16.89	40.00±14.14
P value	>0.50ns	>0.10ns	>0.50ns	>0.10ns	>0.50ns	>0.50ns

Unpaired student's 't' test, ns = Not significant

Table-II shows effect of smoking on blood lead, semen lead and different semen parameters at different blood lead cutoff values (i.e. ≤ 25 and >25 , ≤ 30 and >30 , and ≤ 35 and >35 $\mu\text{g}/\text{dl}$). None of the parameters showed any significant difference between nonsmokers and smokers at different blood lead cutoff values. Blood lead, semen lead and semen volume did not show any significant difference between nonsmokers and smokers at different semen lead cutoff values rather there was significant increase in sperm count, motility, rapid linear motility and morphology among smokers.

When the lead level was analysed irrespective of the smoking status increasing blood lead concentration showed corresponding increase in the mean semen lead concentration. Semen lead level was higher than the blood lead level signifying that lead is concentrated in the semen. At mean blood lead level of $\leq 40/ >40$ $\mu\text{g}/\text{dl}$ semen concentration of lead seemed to double the mean blood lead values and all the semen parameters showed significant negative impact at these values. Reduction of mean semen volume started at level of mean blood lead level of $\leq 40/ >40$ $\mu\text{g}/\text{dl}$. Mean total count of sperm (mil/ml) started lowering at level $\leq 30/ >30$ $\mu\text{g}/\text{dl}$ with very significant reduction of the count at level $\leq 40/ >40$ $\mu\text{g}/\text{dl}$. At mean blood lead level $\leq 35/ >35$ $\mu\text{g}/\text{dl}$ decrease mean values for total motility and rapid linear motility of sperm was observed. Sperm morphology started declining at level $\leq 40/ >40$ $\mu\text{g}/\text{dl}$. 12.3% of the patients had mean lead level above >35 $\mu\text{g}/\text{dl}$. Higher mean blood lead level was associated with significant declining semen parameters.

Discussion

Male fertility is on the decline and the possible role of environmental and occupational and life style factor has encouraged us to do the study. Evidence suggesting that environmental factor can be responsible is claimed in many studies¹⁰. For the developing countries with economic constraint and with limited health facilities for curative measures, preventive health care may spare many from the need of availing the costly procedures like ICSI. In the previous studies higher blood and semen lead level has been linked with lower fertilization rate and estimation of lead level may therefore can be a prognostic factor in the success of IUI, IVF and ICSI⁹. Studies confirm that male sperm counts are declining life style and environmental factors may negatively impact spermatogenesis. Cigarette smoking along with occupation like battery repair, radiators repair, soldering, painting and printing environmental pollution may be a factor for deterioration of sperm quality which is of concern in the recent years. In a study in United Kingdom, Italy, and Belgium the mean blood lead concentration was 31.0 microgram/dl (range 4.6-64.5) in workers exposed to lead and 4.4 $\mu\text{gm}/\text{dl}$ in workers not exposed to lead. Our current blood lead level in infertile smoker or non smoker men is quite high than that shown by Bonde among the non exposed workers¹¹. So search must be done to find out the underlying reason of high level of lead in our population. From the study it seems the level of exposure from smoking is not significant and there is other reason for it.

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