Urinary Excretion of Total and Inorganic Lead in Tetraethyllead Exposed Workers

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Received: 29 September 1997/Accepted: 16 January 1998

Alkyl lead species, particularly tetraethyllead (TEL) have been used as antiknock agents in gasoline for more than 50 years throughout the world (Caplun et al 1984). Then TEL was realized as a very toxic compound causing severe psychotic disorders and also as a main source of lead contamination in urban metropolitan areas. Thus, lead content in gasoline in USA declined sharply since 1975 and the western world followed this reduction a few years later (Shy 1990). Although only lead free gasoline may now be used as an automobile fuel in the USA, leaded gasoline is still used in many countries including Turkey. In Turkey lead content have been reduced to 0.15 g/l in normal gasoline and to 0.4 g/l in super gasoline after 1988. It is also planned to produce unleaded super gasoline beginning from 1998 and only one type of unleaded gasoline after 2003 (TÜPRAS 1994).

Occupational exposure to TEL may occur during the production, transport and mixing of TEL with gasoline and by the cleaning procedure of leaded gasoline storage tanks. Motor mechanics who use gasoline to clean their hands may be particularly at risk especially in our country. These workers exposed to TEL extensively by skin penetration due to the excellent liposolubility of TEL (Grandjean 1979).

In Turkey there is no available data on the occupational TEL exposure, therefore we aimed to investigate the extent of TEL exposure in refinery workers, motor mechanics and gasoline station workers.

MATERIALS AND METHODS

Occupationally TEL exposed subjects were selected from three different occupations: a) Workers employed by petrol refinery plants to fill gasoline storage tanks (refinery workers; n:49), b) Motor repairmen who used gasoline to clean their hands (motor mechanics; n:50) and c) Gasoline station (servicing) workers (n:42). In addition, nonoccupationally exposed people living in the central part of Ankara were studied as a control group (n:35). Urine samples were collected in polyethylene containers without using preservative and samples were...
kept in a deep freeze (-25°C) until analyzed. Total lead and inorganic lead in urine were determined using Varian 30/40 Model, Flame Atomic Absorption spectrophotometer (FAAS) in combination with Slotted Tube Atom Trap (STAT). Slotted quartz tube was supplied from Philips, Eindhoven.

Lead stock solution (100 µg/ml) was prepared by dissolving 0.159 g lead nitrate in 100 ml 1% HNO₃. Stock lead solution was used to prepare working standards in the range of 1.0 - 5.0 µg/ml by appropriate dilution in 1% HNO₃. Calibration, recovery and sensitivity of lead in urine were determined as described by Karakaya and Taylor (1989) and Arai (1996).

The urine sample (40 ml) was transferred to a uniseal decomposition vessel and decomposed with heat and pressure in 5 ml of concentrated nitric acid. The pH was adjusted to 7 and lead was extracted with 2 ml of 3% sodium diethyldithiocarbamate (NDDC) and 5 ml of methyl isobutyl ketone (MIBK). The MIBK layer was used for the determination of total lead (PbT) by FAAS in combination with slotted quartz tube at a wavelength of 283.3 nm (Arai 1986).

Inorganic lead (Pbl) in urine was determined as described by Arai (1986). Accordingly lead was precipitated as lead oxalate in urine. After transferring the precipitate to a uniseal decomposition vessel, the same procedure as described above in PbT determination was accomplished.

Lead levels in urine were also given as µg Pb/g creatinine for the concentration adjustment in spot urine samples (Trevisan 1990). Creatinine in urine was determined as described by Baselt (1980) and was measured directly in urine by reaction with picric acid. The chromogen was measured at 530 nm in a visible spectrophotometer.

The values of control and exposed workers were compared by Students t-test and a p value of 0.05 denoted significance.

RESULTS AND DISCUSSION

The detection limit of STAT-FAAS method was determined 5.2 x 10⁻³ µg/ml for lead. The recovery rates and coefficients of variation (in 10 repetition) are shown in Table 1. We compared also the sensitivities of the conventional FAAS versus STAT-FAAS method and observed an increased sensitivity by approximately 2.5 times for lead (Table 2). The increased sensitivity is due to the longer residence time of analyte atoms in the beam path of the atomic absorption spectrophotometer (Karakaya and Taylor 1989, Vural and Duydu 1995)