Short communication

Blood lead levels in scuba divers: a pilot study

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Abstract

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Introduction: Lead is a toxic element which is known to accumulate in the body. Nevertheless, it is very widely used as a diving weight.

Methods: Blood samples were taken from 20 recreational scuba divers to assess blood lead concentrations.

Results: The last dive before blood sampling was an average of 4.8 weeks previously (range 1–18 weeks). All the samples were within the normal background range, the highest lead concentration being 44.8 $\mu g \cdot L^{-1}$ with an average concentration of 26.5 $\mu g \cdot L^{-1}$ (range 11.7–44.8 $\mu g \cdot L^{-1}$).

Conclusion: The results show no elevated blood lead concentrations in this group of divers compared to background levels. However, owing to the small number of divers studied and the variable, often long interval between the last dive and blood sampling, the results cannot be generalized.

Key words

Scuba diving, toxicity, clinical toxicology

Introduction

Lead is a metallic element found in nature mainly as lead sulphide in combination with other elements (so-called 'galena'). All lead compounds are harmful. Examples of everyday lead-containing products are batteries, insulation, solder for electronic work, X-ray shielding, potable water pipes, ammunition, paints, wood preservatives, as well as its use during glass production.[1,2] The uptake of lead and lead compounds in the human body takes place orally or by inhalation. Transdermal, elemental lead is hardly ever absorbed but organic lead compounds could very well be.

Despite its toxicity, lead is very widely used as a diving weight because of its high density, low price and resistance to corrosion in sea water (see Figure 1 for examples). In this pilot study, we measured the blood lead levels of recreational scuba divers who use lead as diving weights.

Methods

The study was approved by the RWTH Aachen University ethics committee (EK number 020/14) and was carried out in accordance with the Declaration of Helsinki (2013 revision). Subjects were recruited for study through an invitation to participate using the e-mail distribution list of three local diving clubs in Aachen, Germany in April 2014. Divers who used uncoated lead or lead bags as weights were asked for a blood sample. The first 20 recreational scuba divers who met these criteria were included in the study after formal written consent.

The following data were collected: age, gender, profession, smoking habits, total number of dives, and number of dives in the past 12 months, date of last dive, type of diving weights used, age of these weights and any history of possible occupational lead exposure.

Following cleansing of the puncture site with an ethanol solution, a blood sample was collected from a median antecubital vein of each subject into an EDTA tube (Sarstedt S-Monovette EDTA K, 2.7 mL). The blood samples were collected over a period of six weeks in April and May 2014 and were stored at room temperature. Lead concentration was assessed on a single run by a high-resolution, continuum source atomic absorption spectrometer (HRCS-AAS; ContrAA 700, Analytik Jena, Germany) at the Institute of Occupational Medicine at the University Hospital Aachen, Germany in May 2014.

The data were anonymised and statistically analysis was conducted using Microsoft Excel ® (2003) and IBM SPSS® version 22.

Results

Mean age of the 20 divers was 44 years (range 32–59 years). Fourteen of the divers were men and six women. Mean number of dives was 861 (range 80–5,600). Mean number of dives in the last year was 62 (range: 10–200). The last dive before the blood sample was drawn was an average of 4.8 weeks previously (range 1–18 weeks).

The highest serum lead concentration was 44.8 $\mu g \cdot L^{-1}$ with the average lead concentration being 26.5 $\mu g \cdot L^{-1}$ (median 25.4 $\mu g \cdot L^{-1}$; range 11.7–44.8 $\mu g \cdot L^{-1}$). All values were below the reported upper limits of background levels for adults (up to 70 $\mu g \cdot L^{-1}$ in women and 90 $\mu g \cdot L^{-1}$ in men). There was

Figure 1
Top left: V-weight from solid lead; top right: soft weight with lead; below: solid lead pieces on a weight belt

no relationship between the number of dives and the lead level (Pearson product-moment correlation coefficient 0.363, $P = 0.127$) nor between the time interval from the last dive to when the blood sample was taken (Pearson product-moment correlation coefficient -0.290, $P = 0.229$).

Discussion

Upon absorption, lead interacts with the thiol-group of several enzymes, like delta-aminolevulinic acid dehydratase and ferrochelatase, both of which are important for heme biosynthesis. Lead can also modify DNA-methylation.[3] Acute lead poisoning can cause non-specific symptoms such as abdominal, muscle and joint pain, headaches and dizziness, anaemia, nephropathy, and encephalopathy. Mild symptoms may present even at blood lead concentrations below 100 $\mu g \cdot L^{-1}$; severe symptoms can be expected from a concentration of 800 $\mu g \cdot L^{-1}$ upwards.[1] Lead is excreted directly via the kidneys, with a half-life of about 30 days, or stored in the bones.[4] Lead can be released into the bloodstream from bone even after a prolonged period.[2] Chronic or repeated exposure to lead can be asymptomatic but, in addition to the symptoms described above, may lead to cognitive performance degradation, arterial hypertension and foetal damage.[1,5]

To our knowledge, this is the first study to investigate blood lead concentration in recreational divers. Values up to 70 $\mu g \cdot L^{-1}$ in women and 90 $\mu g \cdot L^{-1}$ in men are the upper limits quoted for lead background levels in adults.[6] Therefore, with a maximum value of less than 50 $\mu g \cdot L^{-1}$, there is no evidence of elevated lead levels in this group of 20 recreational scuba divers.

Our study has several limitations. It is not a random sample, but rather the first 20 volunteers. The average time between the last dive and taking the blood sample was 4.8 weeks (range 1–18 weeks). Since the half-life of incorporated lead is about 30 days, this has an appreciable influence on our results, with possibly higher blood lead levels if blood samples had been taken directly after the dive. As a pilot study, the statistical power was not determined. Therefore, furthers studies are merited.

Conclusion

No elevated blood lead levels were measured in a group of 20 divers. Because of study limitations, it cannot be assumed and generalised that divers do not have elevated lead levels from using lead as a diving weight.

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