Bu makale, 2008. Uluslararası Katılımlı Tıbbi Jeoloji Sempozyumu Kitabı (Editör: Dr. Eşref Atabey), ISBN: 978-975-7946-33-5, Sayfa: 112 yayımlanmıştır.

Arsenic, a global public health problem

Arsenik, küresel bir halk sağlığı problemi

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Many millions of people world-wide are exposed to arsenic through drinking water or industrial emissions. While the environmental pollution of arsenic due to industrial emissions and occupational exposure have decreased considerably in most western countries, there is a continuous reporting of the occurrence of arsenic in ground water used for drinking purposes. The reason is that arsenic in the bedrock is easily dissolved into the surrounding ground water. The situation is particularly serious in many low-income countries, where people are prone to use ground water for drinking purposes because of water constrains or pollution of available surface water sources. Often, mitigation possibilities are limited. The use of arsenic-containing ground water for irrigation leads to wide-spread contamination of land and additional exposure via food.

The health consequences of chronic arsenic exposure include various forms of cancer, in e.g. skin, lungs, urinary bladder and kidney. The estimated cancer risk at the current WHO and EU drinking water guideline, 10 µg/L, is in the range 1/1000 to 1/100. There are also numerous non-cancer effects associated with chronic arsenic exposure, including diabetes, skin diseases, chronic cough, toxic effects in liver, kidney, cardiovascular system, peripheral- and central nervous systems. Also, effects on reproduction have been indicated in several studies, but there is limited knowledge about effects on fetal and child development. Also, little is known about susceptible windows of exposure.

Reported mechanisms or mode of action of arsenic include enzyme inhibition, including DNA repair enzymes and enzymes involved in cell cycling, oxidative stress, modification of DNA methylation, interactions with nuclear receptors (e.g. estrogen), and un-coupling of cellular respiration. The mode of action is dose-dependent. There seems to be inter-individual variations in susceptibility to arsenic toxicity. In general, men seem to be more susceptible to the arsenic-induced skin lesions, but little is known about gender differences in other arsenic-related health effects. Other proposed risk modifying factors include age, genetic predisposition, nutrition, concurrent exposure to other toxicants and metabolism of arsenic. Arsenic is metabolized by a series of reduction and methylation reactions, obviously modulating the toxicity. The methylation occurs via one-carbon metabolism with S-adenosylmethionine as methyl donor, and the main metabolites are methylarsonic acid (MA) and dimethylarsinic acid (DMA), which are rapidly excreted in urine. However, intermediate metabolites with arsenic in it's trivalent form, especially MA (III), may contribute to the toxicity. There is a wide inter-individual variation in arsenic metabolism. For example, women seem to have more efficient methylation of arsenic than men.