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Urinary calculi – atypical source of information on mercury in human biomonitoring

Research Article

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Abstract: Chemical analysis of various biological matrices is routinely used for assessment of human exposure to various toxic metals. In this work, 489 samples of urinary calculi originating from almost the whole of The Czech Republic, were collected and subjected to mineralogical and elemental analysis. This study was aimed at mercury, the content of which was determined using thermo-oxidation – cold vapor – atomic absorption spectrometry. The effects of mineralogical composition, sex, age and region were recorded in order to verify the applicability of urinary calculi for biomonitoring. Relationships with other minor and trace elements were also investigated. Association of mercury with whewellite mineral was observed as well as a remarkable relationship with selenium, confirming the role of selenium in mercury excretion. No statistically significant effect was observed on the mercury content in stones with regard to the sex or region. Median values in age groups follow a trend with the maximum median value 0.365 mg kg^{-1} in the group of 41 – 50 year old donors, decreasing to 0.060 mg kg^{-1} for the oldest group (81 – 92 years). Our results confirm that urinary calculi can be helpful in providing complementary information on human exposure to mercury and its excretion.

Keywords: *Urolithiasis • Calculi • Mercury • Biomonitoring • Trace elements*

1. Introduction

Urinary calculi are products of the pathological biomineralization process in the urinary system. Urolithiasis is a frequent disease. There were 22028 patients (13 399 males, 7 629 females) hospitalized in The Czech Republic in 2009 with this diagnosis [1]. Urinary stones consist of about 40 components [2]. The most frequent components are calcium-oxalate (65.2%), phosphates (18.3%) and uric acid (8.7%) [3]. Most of stones are mixtures of two or three components. This disorder has a multifactorial reason of origin and is determined by the physico-chemical conditions of the urinary system.

The effect of different factors on calculi formation has been investigated in several publications; for example, the effect of metals in organisms among others. Occurrence of minor elements (metals) and calculi and the mechanism of their formation in organisms has been studied for more than 35 years [4]. Content of metals in calculi is usually determined and the impact of different factors on the relation of metals and calculi formation is then analyzed [5–11]. Some elements seem to be protective (Zn, Mg) but on the other hand, several elements promote formation of some types of urolithiasis, *e.g.* Fe and Cu [12]. Minor element content in calculi is then explained by its intake from food, metabolism, and the effect of the environment. Results concerning the effect of metals on calculi formation are, however, not unambiguous, and in some cases, conclusions are contrary.

For some elements correlation between element content and mineral content has also been reported [5,11,13–17]. This fact then complicates interpretations of metal content in calculi of different mineralogical composition. Toxic metals at trace levels cannot obviously be considered as urolithiasis promoting factors. Their

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