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Research Paper

Correlation between hair selenium concentration and gastric cancer☆

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Abstract

Objective: To investigate the correlation between hair selenium (Se) level and gastric cancer. **Methods**: Atomic fluorescence spectrophotometer(AFS) was used to detect the Se level in hair. **Results**: The Se concentration in patients with gastric cancer ranged from 0.25 to 2.33 μg/g(0.825 ± 0.51 μg/g), and that of health individuals ranged from 4.23 to 9.21 μg/g(6.29 ± 1.68 μg/g). The results showed that the Se concentration in the patients' hair was significantly lower than that in controls ($P < 0.01$). **Conclusion**: There is a correlation between hair concentration and gastric cancer.

Keywords: selenium; gastric cancer; atomic fluorescence spectrophotometer

INTRODUCTION

Selenium, as an essential biological trace element, has been shown to prevent cancer in animal models and to increase cancer chemopreventive efficacy in human [1]. The anticancer effect of selenium may relate more closely to its ability to enhance the immune response or, more likely, to its ability to produce ant-tumorigenic metabolites (e.g., methyl selenol or its precursors) that can disturb tumour-cell metabolism, inhibit angiogenesis, and induce apoptosis of cancer cells[2,3]. Human need dietary supplement of Se[4], because we cannot synthesize methionine or Se-containing methionine (e.g., selenomethionine). Both synthesizing methionine or Se-containing methionine are proportionally incorporated into protein tissues based on their circulating level and the tissue requirement for methionine. Some selenomethionine is converted to selenocysteine for production of seleno enzymes (e.g., glutathione peroxidase)[5]. As a substrate for the selenium-containing enzyme glutathione peroxidase, GSH protects against peroxidase-induced cellar damages. Hair Se is unavailable for further body utilization, as its nutrient components do not re-enter body circulation. This site can be considered as essentially inert and can thereby largely be considered as an excretory route for Se [6]. The advent of Atomic Fluorescence Spectrophotometer(AFS), with its multi-element capacity, sensitivity, and ability for measuring a large concentration range, has been able to measure trace elements in hair. In the present study, we detected Se in hair among the gastric cancer patients and health controls to evaluate the correlation between hair Se concentration and gastric cancer.

MATERIALS AND METHODS

Instruments

AFS-930, Atomic Fluorescence Spectrophotometer (Titan, China), Se High Performance Hollow Cathode Lamp (Titan, China).

Reagents

Selenium (Se) standard solution was purchased from National Research Center for CRM. The chemical reagents used in this work were of guaranteed reagent, and demineralized water (18.2 MΩ) was used.

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Samples preparation

We collected about 200 mg hair sample in occiptonuchal region from 20 patients with gastric cancer. Biologically unrelated cancer-free individuals were recruited as controls who were living in the same residential area, and frequency-matched to the cases on age (± 5 years) and sex. All cases and control subjects provided informed consent to participate in the study and donated 200 mg hair. The participants used the same brand shampoo low in selenium before the experiment. Samples of 1-2 cm in length were washed with ether, sodium lauryl sulfate detergent in demineralized water and acetone in sequence, and dried between two filter papers.

Procedures

At room temperature, 100 mg sample was taken and digested in a volumetric flask with a mixture of nitric acid and perchloric acid. The resultant solution was then diluted to 10 mL with demineralized water. This solution was then mixed with 5 ml of HCl (37%)and heated for 3-5 min at 90°C. The solution was finally diluted up to 25 ml with demineralized water, and analyzed by HG-AFS according to standard techniques and procedures. 37% hydrochloric acid and 1.5% (w/v) sodium borohydride (NaBH4, 99%) in solution of 0.2% (w/v)sodium hydroxide (NaOH) for hydride generation were prepared daily. All glasswares were cleaned with ethylenediamine tetraacetate and detergent in demineralized water before use.

Statistical analysis

Data were presented as mean ± SD and were analyzed with SPSS 12.0. All tests of statistical significance were two-sided at the level of P value < 0.05.

RESULTS

Se concentration in hairs among the gastric cancer group and health controls

The average level of Se in patients with gastric cancer was 0.825 ± 0.51 μg/g , and that of healthy controls was 6.29 ± 1.68 μg/g. Compared with the control group, hair Se concentration in gastric cancer patients was significantly lower ($P < 0.01$).

Working curve, linear range and detection limit

Under the optimal working condition, the working curve of Se was drawn. It showed that its linear range was 0 to 10μg/L, coefficient correlation was 0.9997, and regression equation was I= 118.4249*C +25.7635. The detection limit of Se was obtained, which was 156pg (K = 3).

Recovery rate

The proposed method was used to determine Se in hair. At the same time, the standard adding method was used to calculate the recovery. And the recovery was from 90.5% to 102.2%. The results were shown in ***Table 1***.

Table 1 **Recovery Rate of the Method**

Sample number	Concentration of Se in sample (ng/ml)	Added (ng/ml)	Found (ng/ml)	Recovery rate (%)
1	1.2	10	11.04	98.6
2	1.6	20	19.55	90.5
3	2.3	50	53.45	102.2

From the results of the experiment, it showed that Se levels in patients' hairs were lower than those in health control's. This difference was statistically significant ($P < 0.01$). Furthermore, we found that the AFS method was highly recovered with high reproducibility, suggesting that the AFS method was convenient, precise and reliable to determine Se in hair.

DISCUSSION

Hair mineral analyses are being performed frequently both with and without medical advice. The use of hair has a potential advantage in examining exposure to toxic minerals and the nutritional status of essential minerals because hair reflects the status of trace elements over a long time frame and is not transiently disturbed by each meal. Nevertheless, the interpretation of the results of hair measurements is sometimes difficult because the systemic distribution of each element is not fully understood. It is likely that the absorbed trace elements are heterogeneously distributed among organs, which may cause discrepancies between the concentrations in hair and those in the internal organs of people on a normal diet. Nevertheless, when there are larger perturbations, such as with toxicosis or malnutrition in various pathological conditions, the systemic changes in several elements are thought to be reflected in hair[9]. It is assumed that trace elements in hair reflect trace elements in organs or important body pools. Selenium levels in hair have been shown to positively correlate with those in the plasma, kidney, liver, and lung[7-8]. Hair Se level may be used to determine the body Se store, but whether it can accurately assess the changing Se status of human has been questioned.

Selenium, a constituent of antioxidant enzyme,

has been proposed as a chemopreventive agent for many kinds of cancer[10-13]. Gastric cancer is the second most frequent cause of cancer death worldwide and the leading cause of cancer death in China. Studies have been focused on randomized nutritional intervention trial to prevent gastric cancer [14-18] and epidemiology in serum selenium concentration and gastric cancer [19]. Wu et al.[20] reported that gastric cancer tissues had significantly higher concentrations of Fe, K, Mg, Na, Rb, Se, and Zn than normal gastric mucosal tissues. We suppose that enrichment of Se in gastric cancer tissues may cause Se deficiency in hair. The mechanisms need further investigation.

CONCLUSION

Our results demonstrated a high correlation of hair Se to gastric cancer, suggesting that hair Se might be effective to evaluate the Se status of patients with gastric cancer. Hair AFS analysis was a feasible method for such monitoring. However, the relationship between hair in deficient condition and the threshold value indicated that the clinical ase of hair AFS analysis should be individecalized.

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