

A study of the relationship between trace element Mo and gastric cancer *

CAO Guang-Hui¹, YAN Shi-Ming², YUAN Zhao-Kang², WU Lei² and LIU Yan-Fang²

Subject headings stomach neoplasms/mortality; molybdenum/analysis; trace element; risk factors

Abstract

AIM To study the relationship between trace element Mo and gastric cancer.

MATERIALS AND METHODS Soil samples were collected according to its type in different areas of Jiangxi Province; available molybdenum content in soil was measured by catalytic polarography and rank correlation method was used to analyse correlation between the mean of soil available molybdenum and mortality rate of gastric cancer in each county and city in Jiangxi Province. Gastric cancer cases were selected from the authors' hospital, occiput hair was collected to measure its molybdenum content with an atomic absorption spectrograph and controls were selected from the same hospital for comparison. Gastric cancer cases were selected from three hospitals at the same time, blood samples were taken on an empty stomach and serum molybdenum contents were measured with the atomic absorption spectrograph, and controls were selected from the same hospitals. Blind method was used in the whole course (chemical analysts did not know the source and nature of samples).

RESULTS A negative correlation existed between soil available molybdenum content and mortality rate of gastric cancer ($r = -0.285$, $P < 0.05$); hair molybdenum contents of gastric cancer cases were lower than those of healthy controls ($0.308 \mu\text{g/g} \pm 0.673 \mu\text{g/g}$ and $0.707 \mu\text{g/g} \pm 0.561 \mu\text{g/g}$ respectively, $P < 0.01$); serum molybdenum contents of patients were also lower than those of healthy controls ($21.84 \mu\text{g/L} \pm 7.49 \mu\text{g/L}$ and $25.38 \mu\text{g/L} \pm 8.58 \mu\text{g/L}$ respectively, $P < 0.05$).

CONCLUSION Deficiency of molybdenum may be one of the risk factors in gastric cancer.

¹Department of Internal Medicine, Second Affiliated Hospital, Jiangxi Medical College, Jiangxi Province 330006, China

²Faculty of Preventive Medicine, Jiangxi Medical College, Nanchang 330006, China

Dr. CAO Guang-Hui, male, born on 1942-07-04 in Boyang County, Jiangxi Province, graduated from Jiangxi Medical College in 1967, associate professor and vice-director of department of internal medicine, having 30 papers and 2 books published.

Tel: +86-0791-6265564 Fax: +86-0791-6262262

*Project supported by National Science Foundation of China, No. 39360071.

Correspondence to Dr. CAO Guang-Hui, Department of Internal Medicine, Second Affiliated Hospital, Jiangxi Medical College, Jiangxi Province 330006, China

Received 1997-05-28

INTRODUCTION

A study of risk factors in gastric cancer in Jiangxi Province was started in 1983. The relationship between the soil trace element molybdenum (Mo) contents and mortality rates of gastric cancer in different areas of the province was investigated, and hair and serum Mo contents of gastric cancer cases and controls were determined.

MATERIALS AND METHODS

Eighty-five of 91 counties or cities in the whole Jiangxi Province were chosen for soil Mo determination. A total of 1748 soil samples were taken from farming areas. The characteristics of the representative areas were: nonirrigated farmland of 12 thousand mu; paddy field of 25 thousand mu, hilly and mountainous region (reclaimable wasteland) of 105 thousand mu. Samples were separately packed into plastic pockets, filtered through nylon sieves and digested by oxalic acid-ammonium oxalate. Mo in the extract thus obtained was measured by catalytic polarography. Twenty-three gastric cancer cases from the 2nd Affiliated Hospital of Jiangxi Medical College and 152 non-cancer controls of similar age and sex were chosen for the study. Occiput hair samples (3%) were obtained from each case and control, impregnated in detergent, rinsed, desiccated and acidified for the measurement of Mo contents with an atomic absorption spectrometer (HITACHI 8000).

Another group of gastric cancer and non-cancer matched controls were from the First and Second Affiliated Hospitals of Jiangxi Medical College and Jiangxi Tumour Hospital diagnosed from January to March in 1993 and 1994. Blood samples of these subjects were taken on empty stomachs in the morning. Serum Mo contents were determined with an atomic absorption spectrograph (SHIMATSU A-A 680, Japan).

RESULTS

Relationship between available molybdenum and mortality rate of gastric cancer

Soil samples were collected from different areas of the whole province, including gastric cancer high-incidence county Gui Xi and low-incidence county Hui Chang. About 20 samples were taken from each county or city. The mean of available Mo in soil was calculated. The correlation between the mean of soil available Mo and mortality rate of gastric cancer in each county or city was analysed by rank correlation. The result was $r = -0.285$, $P < 0.01$, which indicated a negative correlation between soil available Mo and mortality rate of gastric cancer.

Comparison of hair molybdenum between gastric cancer cases and healthy controls

Twenty-three gastric cancer cases were all definitely diagnosed by barium meal study, gastrocopy or biopsy. Among them, 18 were males and 5 females, aged from 30 to 70 years, averaging 52.2 ± 12.4 . A total of 152 healthy persons served as controls. The mean of hair molybdenum content of the 23 gastric cancer cases was $0.308 \mu\text{g/g} \pm 0.673 \mu\text{g/g}$, being lower than that of the control group ($0.707 \mu\text{g/g} \pm 0.561 \mu\text{g/g}$) ($P < 0.01$). The difference was significant.

Comparison of serum molybdenum between gastric cancer cases and non-cancer controls

There were 33 gastric cancer cases, with age ranging from 27 to 80 years (average 54.4 years), and a male:female ratio of 1.00:1.06. There were 79 non-cancer controls, aged from 29 to 83 (average 48.1 years) with a male:female ratio of 1.00:1.13.

Serum molybdenum contents were 21.84 ± 7.49 in the gastric cancer group and 25.38 ± 8.85 in the controls, ($t = 2.18, P < 0.05$).

Serum molybdenum contents in gastric cancer cases were lower than those in non-cancer controls, the difference being significant.

DISCUSSION

Molybdenum has important physiological functions in human body. It is one of the essential trace elements. Low molybdenum content in soil has been thought to be one of the factors involving a high incidence of esophageal cancer and Keshan disease^[1,2]. But there have been few reports about the relationship between trace element molybdenum and gastric cancer.

Our study showed a negative correlation ($r = -0.285, P < 0.01$) between soil Mo and mortality rate of gastric cancer. Soil available Mo contents were all low in these counties and cities with high mortality rate of gastric cancer such as Gui Xi. Lack of Mo in soil results in inadequate contents in corn and livestock which in turn, affects human body. Molybdenum is a component of nitrite reductase. In the process of the reduction of nitrate to nitrogen which can then be utilized by plants, the participation of molybdenum is indispensable. In the soil deficient of molybdenum, only part of nitrate can be reduced, thus leaving more nitrite in the environment and corn. This makes the human body and animals absorb and store more nitrites which under certain circumstances combine with nitrogenous substances to form nitrosamines, a group of strong carcinogens. Furthermore, molybdenum has some effects on the synthesis of vitamin C in plants, which may inhibit synthesis of nitroso-compounds in the human body^[3]. To sum up, we can say that lack of molybdenum in the environment may obviously influence nitrogen fixation and transformation of soil nitrates as well as compound formation, and that Mo deficiency is definitely related to a high mortality rate of gastric

cancer in local inhabitants.

Hair and serum molybdenum contents of gastric cancer cases were lower than those of healthy controls. The difference was statistically significant. This indicates that lack of molybdenum in the human body may be one of the causes of gastric cancer. Zhou *et al* found that molybdenum level in the mucosa of patients with gastritis or gastric ulcer was lower than that of normal people ($P < 0.01$), and that its level in mucosa of gastric cancer patients was also decreased^[4]. This indicated that molybdenum deficiency may be an important factor in the causation of gastric disease. Wei *et al* used *N*-nitroso-sarcosine-ethyl (NSEE) induced mouse foregastric squamous carcinoma model for studying the effect of molybdenum on carcinogenesis and proved that molybdenum had an obvious inhibitory effect on mouse foregastric squamous carcinoma^[5]. Miller^[6] reported that most chemical carcinogens were metabolized by cytochrome P-450 in cells, producing "end-stage carcinogen" with electrophilic groups and then brought about cell deterioration. P-450 also had some relationship with its effect on the detoxification of carcinogens in the body. Lu *et al* studied the effect of molybdenum on the activities of P-450 and demethylase in rat liver and found that small dose of molybdenum could speed up detoxification of carcinogens and large dose of molybdenum might slow down that effect relatively^[7]. Basing on the literature and our results, we can infer that some amount of molybdenum in the human body may lower the intake and thereby the contents of nitrate and nitrite in the body and enhance detoxification of carcinogens so as to give a protective action on the gastric mucosa. The content of molybdenum in human body may be related to molybdenum level in the environment. In a relative molybdenum-deficient environment, is human body also in a relative molybdenum-deficient status. Is it useful to give a proper supplement of molybdenum to the people or give molybdenum-containing fertilizer for the prevention of carcinoma (especially against gastric cancer) in Modeficient areas. These questions remain to be answered.

In conclusion, we have reasons to think that lack of molybdenum may be one of the risk factors in gastric cancer.

REFERENCES

- 1 Yang GH. Molybdenum and esophageal carcinoma. *FMS: Medical Geograph*, 1990;(1):12 - 14
- 2 Gai XD. Research of effect of lack of molybdenum and nitrite toxication in Ke Shan disease. *Chin J Control Endemic Dis*, 1989;4(5):267 - 269
- 3 Kong XL. Nutritional, physiological and clinical significance of essential trace elements. Hefei: Anhui Science and Technology Publishing House, 1982:353-355
- 4 Zhou WG, He LZ, Lin WY, Luo JH. Trace element measurement in gastric mucosa of gastric disease patients. *Guangxi Med*, 1990;12(5):298 - 300
- 5 Wei HJ. Effect of molybdenum on *N*-nitroso-sarcosine-ethyl causing mouse foregastric squamous carcinoma. *Trace Element*, 1986;(2):6 - 8
- 6 Miller EC. Some current perspectives on chemical carcinogenesis in human and experimental animals. *Cancer Res*, 1978;38:1479
- 7 Lu SX, Tian Y, Li FM. Effect of molybdenum on P-450 and the activity of demethylase in rat liver. *Chin J Oncology*, 1984;6(4):257 - 259