

TRACE ELEMENTS IN HAIR OF TAIHANG MOUNTAIN MONKEYS WITH ESOPHAGEAL PRECANCEROUS LESIONS

ZHANG Hongxu 张红绪, KONG Xianghui 孔祥会, WAN Xia 宛霞, ZHAO Xiaojin 赵晓进
ZHAI Xinhui 翟心慧, GUO Mei 郭玫, XU Cunshuan 徐存栓

College of Life Sciences, Henan Normal University, Xinxiang, Henan Province 453002, China

ABSTRACT

To investigate the changes of trace elements in the hair of Rhesus monkeys with esophageal precancerous lesions from Taihang Mountain. **Methods:** The quantities of trace and other elements including Cu, Zn, Fe, Mn in the hair of Rhesus monkeys were determined using atomic absorption spectrophotometry. **Results:** Compared with normal subjects, Fe content is remarkably higher in the cases of esophageal epithelium proliferation ($P < 0.01$), and Cu content is significantly higher in those with high proliferation ($P < 0.05$); The results showed no marked difference in the quantities of Zn and Mn between the cases and the normal ($P > 0.05$). **Conclusion:** the present study may provide some basic information foundation for the study of the human esophageal cancer.

Key words: Rhesus monkey, Precancerous lesions, Trace elements

In recent years, there has been much research done on the changes of trace elements in the cancerous tissues of the esophagus, stomach, liver, intestines, mammary glands and others, and in the serum of the patients with dementia or epilepsy.^[1-3] However, most samples in these studies were taken from the tissues of cancerous lesions and there was no report on the changes of trace elements in esophageal carcinoma of the animals or in the development of cancerous lesions. In this paper, we attempt to seek trace elements in the course of esophageal precancerous lesions of the Rhesus by analyzing the contents in hair of Rhesus monkeys, and to provide an important scientific basis for the prevention, prohibition and the law of occurrence and development of esophageal cancer.

Accepted for publication: October 15, 1999

Correspondence to: Zhang Hongxu, College of Life Sciences, Henan Normal University, No. 148, Jianshe Road, Xinxiang City, Henan Province 453002, China;
Phone: (0086-373)-3326340; Fax: (0086-373)-3326524;
E-mail: peanut@public.xxptt.ha.cn

MATERIALS AND METHODS

Animals for experiments

The Rhesus monkeys studied were all caught in the high morbidity area of esophageal cancer - the Taihang mountain area in China (Huilong Mountain Area between Hui County and Lin County and Jiyuan Mountain Area of Henan Province). They were put in cages and raised in the breeding center of our university. We selected those monkeys who were over 3 years old and weighted over 5.0 kg, 12 of which were males and other 10 females. According to the standards reported by Zhang Hongxu, et al.^[4] the proliferation of the epithelium in the esophagus of Rhesus monkeys was classified into normal (N), light (LP) and high proliferation (HP).

Sampling and Treating

The hair of Rhesus monkeys was taken at the same time from the occiput area, 0.3 cm away from the scalp, then washed, oven dried and sterilized.

Apparatus for Measurement

AA-670 Atomic Absorption Spectro-Photometer made by Shimadzu Corporation, Japan.

Conditions for Measurement

The wavelength used for each element is as follows:

Zn: $\lambda = 213.9$ nm; Cu: $\lambda = 324.8$ nm;
Mn: $\lambda = 279.6$ nm; Fe: $\lambda = 248.3$ nm.

RESULTS

In the hair of Rhesus monkeys of esophageal epithelium proliferation, Cu content is higher, Fe contents remarkably higher, but Mn, Zn contents are lower than those in the normal subjects, respectively (Table 1).

In the hair of the Rhesus monkeys with

esophageal proliferation, the value of Cu/Zn does not have remarkable difference with the normal (Table 2).

The comparison between sexes shows that Cu

content does not have remarkable difference in the hair of Rhesus monkeys of esophageal proliferation and the normal (Table 3).

Table 1. The Quantities of trace elements in the hair of Rhesus monkeys with esophageal epithelium proliferation and of the normal $\bar{x} \pm s$ ($\mu\text{g/g}$ dried weight)

Groups	No. of cases	Cu	Zn	Mn	Fe
LP	9	12.05 \pm 1.37	197.51 \pm 93.60	56.48 \pm 39.60	430.79 \pm 107.0*
HP	5	12.80 \pm 1.02*	198.94 \pm 70.62	28.84 \pm 13.12	457.21 \pm 143.74**
N	8	11.60 \pm 1.04	226.68 \pm 86.27	99.28 \pm 13.38	303.85 \pm 91.03

* $P < 0.05$, signal difference; ** $P < 0.01$, remarkable difference.

Table 2. the value of Cu/Zn in the hair of Rhesus monkeys with esophageal epithelium proliferation and of the normal $\bar{x} \pm s$ ($\mu\text{g/g}$ dried weight)

Groups	No. of cases	Value of Cu/Zn	P value
Proliferation	14	0.0667 \pm 0.18	>0.05
Normal	8	0.0612 \pm 0.0145	

Table 3. Comparison of Cu content between the sexes in the hair of the cases and of the normal $\bar{x} \pm s$ ($\mu\text{g/g}$ dried weight)

Groups	\bar{x}	No. of cases	s	No. of cases
Proliferation	12.303 \pm 1.38	7	11.27 \pm 2.32	7
Normal	11.146 \pm 0.448	5	12.755 \pm 1.03	3
P value	>0.05		>0.05	

DISCUSSIONS

Our study indicates that in the hair of the Rhesus monkeys with severe proliferation of esophageal epithelium, the Cu content was higher than that in the monkeys of light proliferation and the normal in that order. Table 1 also shows that there was a remarkable difference ($P < 0.05$) in the content of Cu between the monkeys of high proliferation and the normal. At the same time, Table 3 states that the above difference is not related to sex. These results were consistent with those reported by Hu Guogang in 1985^[1]—the quantities of Cu in serum, hair and cancer tissues of the patients of tumor are higher than those in the normal group. The results also indicate that in the process of occurrence and development of esophageal precancerous lesions, the Cu content increases progressively. It further confirms that the increase of Cu content is one of the characters of the cases with esophageal cancer.^[1]

Our experiment shows that Zn content in hair of Rhesus monkeys with precancerous esophageal lesions was lower than that in hair of the normal. However, there was no significant difference between

the patients and the normal. This result is consistent with the findings that Zn contents in many kinds of cancer tissues are lower than that in the normal, which were reported by Liu Xiaoguang,^[5] Jin Yuquan,^[2] W.J. Porie,^[6] H.J. Lin^[7] and Hu Guogang.^[1] In general, Zn content in hair of human and animals is stable. When Zn content in the body is low, the Zn content in the hair is also low, so Zn content has the clinically diagnostic value.^[8] Zn is an element in over seventy kinds of enzymes. It relates to the synthesis and metabolism of nucleic acids and protein, and is also one of the important factors to maintain the differentiation of the normal epithelium. The fact of low Zn content in the Rhesus monkeys with esophageal precancerous lesions may be an important factor to cause the proliferation.

The value of Cu/Zn in hair of the Rhesus monkeys with esophageal precancerous lesions was higher, but not remarkable higher than that in the normal. This result is consistent with the fact that the average value of Cu/Zn is higher in the blood serum of patients with esophageal carcinoma than in blood serum of the normal, as reported by Zheng Sufang^[9] and Hu Guogang.^[1]

At the present time, the relation between Fe and the cancer lesions is not yet confirmed, but many experiments indicate that some relations exist there. Usually, Fe is separated and confined in a particular area in the body by a macromolecule and only allowed to perform its particular physiological action. The confinement of Fe may be removed before or in the course of cell division. It then produces free bases. The free bases can make disordered metabolism. The metabolic disorder causes the cell division to be out of control and makes it degenerate into cancer.^[10] So someone believes that removing Fe may inhibit the formation of tumor.^[11] Our experiment indicates that Fe content in the hair of the Rhesus monkeys with esophageal precancerous lesions was higher than that in the normal, and the difference was remarkable ($P < 0.01$). This result may be thought of as a supplement and support to the above-mentioned points of view.

Most of researches show that Mn content in the hair of the patients of cancer was lower than that in the normal. Our experiment indicates that Mn content in the hair of the monkeys of esophageal carcinoma proliferation was also lower than the content in the normal, but with not a marked difference ($P > 0.05$). Also the Mn content greatly varies with individuals and may have a difference up to 10 or even 100 times. There was no explanation to the difference of Mn content. All these are consistent with those reported by Hu Guogang.^[11]

Hair is one of the places where the trace elements are deposited and excreted in for human and animals, so the changes of trace elements in the hair may reflect the changes of trace elements in the body to a certain degree. Furthermore, sampling, saving, carrying and determination of the hair is very simple and convenient, so the hair may be used to investigation the epidemiology of some trace elements in the human body. However, because the quantities of trace elements in hair are easily affected by the internal and external factors, one should not consider the relation between the trace elements and disease in terms of the content of the trace elements in hair. A more scientific way would be to consider the trace elements in hair, tissues and body fluids all

together.

REFERENCES

- [1] Hu Guogang, Luo Xianmao, Joan D C, et al. Analysis of trace elements in hair, blood serum and cancer tissues of the patients of esophageal cancer. *Chin J Oncol* 1985; 7:181.
- [2] Jin Yuquan, Li Riyong, Jin Rensou, et al. The cancer of stomach, large intestine, mammary cancer and tissues around the cancer, and comparison of contents of seven trace elements in the corresponding tissues. *Chin J Oncol* 1992; 14: 395.
- [3] Jiang Huimin, Han Guoan, Cui Xi, et al. The clinical value of determining the trace elements in the blood serum and cerebrospinal fluid to the diagnosis of the brain tumor. *Chin J Oncol* 1991; 13: 210.
- [4] Zhang Hongxu, Zhao Xiaojin, Hou Jinhui, et al. Study on the precancerous esophageal lesions of Rhesus monkeys from Taihang area of high morbidity of esophageal carcinoma. *Chin J Cancer Res* 1996; 8:5.
- [5] Liu Xiaoguang, He Ersitai, Zheng Fumin, et al. Study on the metabolic changes of trace elements Cu, Zn and Se in the body of patients with cancer of stomach. *Chin J Oncol* 1991; 13:93.
- [6] WJ Pories. Trace elements that act to inhibit neoplastic growth: Geochemical environment in relation to health and disease. *Ann of NY Acad Sci* 1972; 199: 265.
- [7] Lin HJ, Chan WC, Fong YY, et al. Zinc levels in serum, hair, tumors from patients with esophageal cancer. *Nutr Rep Inter* 1977; 15: 635.
- [8] Zhao Liming. Zn and pregnancy. *Progress in Physiology* 1988; 19: 1.
- [9] Zheng Sufang, Liu Xinfu, Li Qianhn. Analysis on contents of Cu, Zn and Mg in the blood serum of patients with esophageal and cardiac cancer and in the normal. *Cancer Res Prevention Treatment* 1980; 6: 4.
- [10] Li Shuzhen. *Essential elements and health*. 1st ed. Beijing: Light Industry press 1988; 58.
- [11] Wang Kui. *The trace elements in the life science* (Vol.1, 2) 1st ed. Beijing: Chinese Measurement Press 1992; 472.