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Biogenic and Toxic Metals Content in Cancerous Tissues and Adjacent Normal Tissues of Digestive System of Human

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***Abstract*— Annually, about 12 000 men and 11 000 women die because of cancer of digestive system in Poland. Conclusive scientific evidences obtained as a result of many investigations prove the fact that improper diet is among one of the most important reasons of cancer processes induction. Even a little change in lifestyle expressed by dietary habits such as limitation of table salt, marinated foodstuffs, fats, consumption and raise of fresh vegetable, fruits and high-fibre foods consumption make risk of cancer disease much smaller. An important task for scientists and teachers is systematic work the effects of which would convince people that the most effective is the prevention of the disease. The research was conducted on samples taken from different segments of human digestive tract. Tissues were taken during biopsy, surgery, and post-mortem. Fragments of tissues, cancerous and adjacent normal ones, were taken from esophagus, stomach, small and large intestines. Samples were dried and mineralized. Metal contents of sodium, potassium, calcium, magnesium, copper, zinc, iron were detected using the FAAS method. Mercury contents were detected using CVAAS methods. All the results were expressed in micrograms per gram of dry mass of the tissue. The falsification of the hypothesis was made by U Mann-Whitney test and Kruskal-Wallis ANOVA. The obtained results showed unambiguously that the contents of all biogenic metals were higher in healthy tissues of men and women in comparison to patients with cancer. On the other hand, mercury contents were much higher in patients with tumors (both men and women) in comparison to healthy tissues of both sexes. The results suggest that cancerous tissues may accumulate toxic elements more effectively and that biogenic elements concentration is disturbed. The most important is to recognize if these processes are the reason of the influence of cancerous processes.**

Keywords-component; toxic metals, biogenic metals, digestive system cancer

I. INTRODUCTION

Annually, about 12 000 men and 11 000 women die because of cancer of digestive system in Poland. Conclusive scientific evidences obtained as a result of many investigations prove the fact that improper diet is among one of the most important reasons of cancer processes induction. Even a little change in lifestyle expressed by dietary habits such as limitation of table salt, marinated foodstuffs, fats, consumption and raise of fresh vegetable, fruits and high-fibre foods consumption make risk of cancer disease much smaller. An important task for scientists and teachers is systematic work the effects of which would convince people that the most effective is the prevention of the disease. The research was conducted on samples taken from different segments of human digestive tract. Tissues were taken during biopsy, surgery, and post-mortem. Fragments of tissues, cancerous and adjacent normal ones, were taken from esophagus, stomach, small and large intestines. Samples were dried and mineralized. Metal contents of sodium, potassium, calcium, magnesium, copper, zinc, iron were detected using the FAAS method. Mercury contents were detected using CVAAS methods. All the results were expressed in micrograms per gram of dry mass of the tissue. The falsification of the hypothesis was made by U Mann-Whitney test and Kruskal-Wallis ANOVA. The obtained results showed unambiguously that the contents of all biogenic metals were higher in healthy tissues of men and women in comparison to patients with cancer. On the other hand, mercury contents were much higher in patients with tumors (both men and women) in comparison to healthy tissues of both sexes. The results suggest that cancerous tissues may accumulate toxic elements more effectively and that biogenic elements concentration is disturbed. The most important is to recognize if these processes are the reason of the influence of cancerous processes.

II. AIM OF THE STUDY

Previous study concerning the concentration of biogenic and xenobiotic metals in tisssues of digestive system are sparse and diversified. The objectives of this study were to determine the mean concentration of biogenic (Cu, Zn, Fe, Na, K, Mg, Ca) and xenobiotic (Hg) metals in cancerous and normal tissues of digestive system.

III. METHODS

The research was conducted on samples taken from different segments of human digestive tract. Tissues were taken during biopsy, surgery, and post-mortem from Military Hospital and PROSMED Health Center in Cracow. Permission for the research was given by Local Bioethical Commission (nr KBET/95/B/2009). Fragments of tissues, cancerous and adjacent normal, were taken from esophagus, stomach, small and large intestine, and then frozen. Average mass of each sample hesitated from 0,5-1g. Samples were taken from 54 (n=54) patients, among them 28 were cancer tissues (n=25 large intestine tumor, n=3 stomach tumor) and 26 normal tissues (n=11 esophagus mucous, n=17 stomach mucous, n=12 small intestine mucous, n=19 large intestine musous). Samples were dried at 80ºC for 24 hours, then at the increased temperature of 105ºC, and dried for seven days until dry mass was obtained. All the dry material of each sample was weighted and placed in a separate mineralization tubes and mixed with 1 cm3 of 65% HNO3 and heated at 105°C for 120 minutes in a thermostat-controlled digestion block, VELP Scientifica DK 20. After cooling, the samples were filled to the volume of 10 cm3 with demineralized water. Metals such as sodium, potassium, calcium, magnesium, copper, zinc, iron contents were detected using the FAAS method. Mercury contents were detected using CVAAS methods. All the results were expressed in micrograms per gram of dry mass of the tissue. The falsification of the hypotheses were made by U Mann-Whitney test, and Kruskal-Wallis ANOVA.

IV. RESULTS

In our study we determined the presence of all the tested metals (Na, K, Mg, Ca, Zn, Cu, Fe and Hg) in cancerous and adjacent normal tissues of stomach and large intestine. Results are shown in figure 1-8.

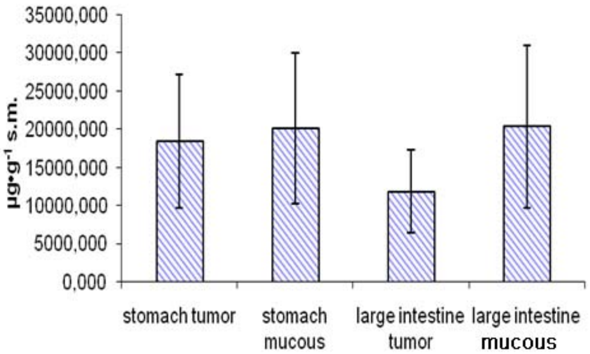

Figure 1. Mean concentration of Na in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

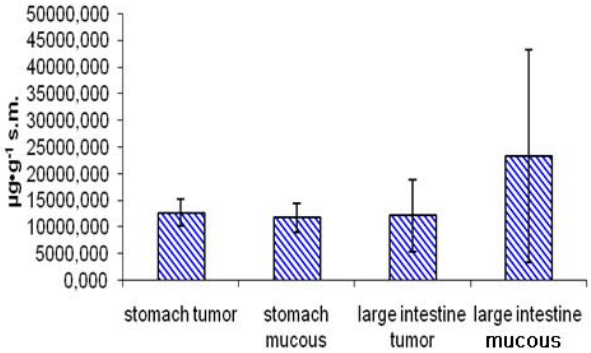

Figure 2. Mean concentration of K in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

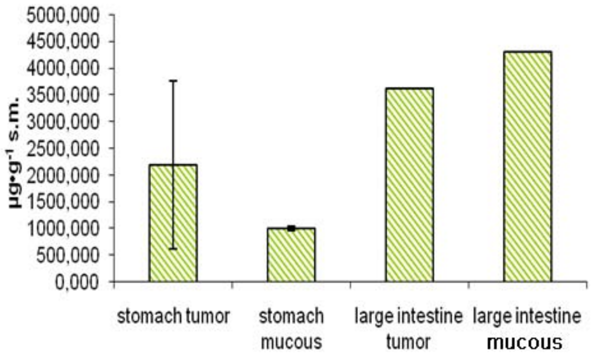

Figure 3. Mean concentration of Ca in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

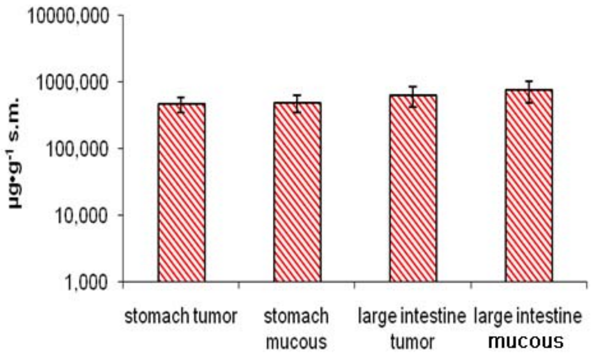

Figure 4. Mean concentration of Mg in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

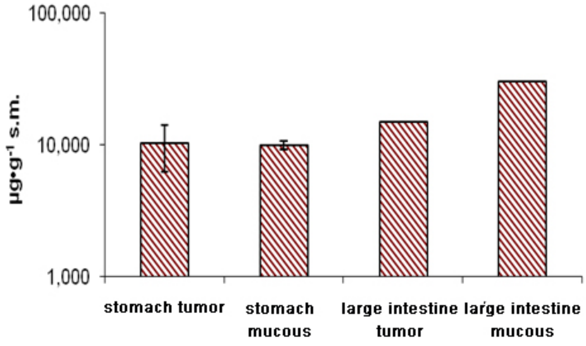

Figure 5. Mean concentration of Cu in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

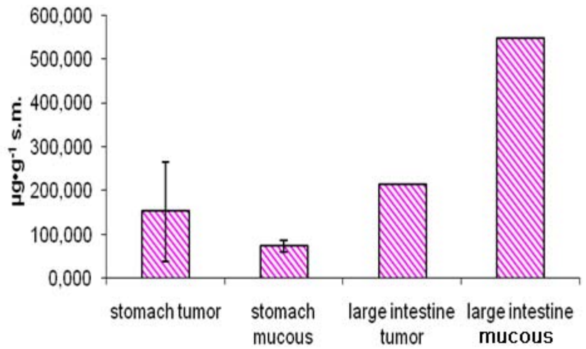

Figure 6. Mean concentration of Zn in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

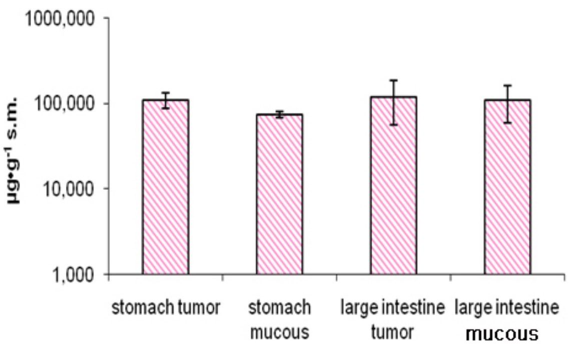

Figure 7. Mean concentration of Fe in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

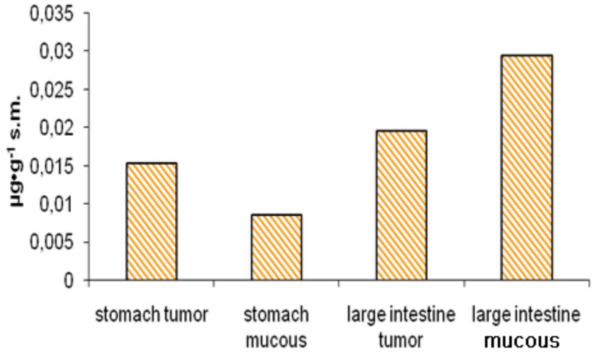

Figure 8. Mean concentration of Hg in cancerous and adjacent normal tissues of stomach and large intestine (µg·g^{-1} dry mass±SD)

V. DISCUSSION

As far as sodium is concerned, higher mean concentration was observed in healthy adjacent normal tissues of stomach cancer (20128.699 µg·g^{-1} dry mass) and large intestine in comparison to the mean levels of Na in cancerous tissue of stomach and large intestine. Mean concentration of potassium in adjacent normal tissues of large intestine tumor is higher than in the tumor itself. It is proved that in case of stomach cancer the mean level of K is higher than in normal tissue, a possible explanation for it being the fact that potassium channels (KCh) are involved in cancer development [7]. However, our results suggest that in case of large intestine tumor potassium channels did not play such a role. The literature data are insufficient in this respect, though. Also, the mean concentration of calcium was higher in stomach tumor (2185.166 µg·g^{-1} dry mass) compared with healthy tissues (999.885 µg·g^{-1} dry mass). It shows too low a level of this element in healthy tissues of people with cancer what can induce carcinogenesis in stomach. Moreover, some results suggested that Ca has protective properties against stomach cancer [8]. On the contrary, the mean concentration of Ca is higher in adjacent normal tissues of large intestine than in tumor. It is proved that both high dietary intake and supplementation of Ca can decrease the risk of large intestine cancer [9,10]. Higher level of magnesium in adjacent normal tissues of stomach and large intestine compared with tumor suggested that this metal, similarly as Ca, has protective function against cancer, but literature data are ambiguous. The data concerning Cu as the inhibitor of carcinogenesis are divergent; in our study the obtained Cu values were similar both in adjacent normal and tumor tissues. The role of zinc in human cancer diseases is not fully explained. Some authors suggest that Zn can stop the growth and development of the colon cancer [11]. In our study, the mean concentration of Zn in cancer tissues is higher than in adjacent normal tissues of stomach and large intestine. Our results concerning Fe level in large intestine tumor are in accordance with Reddy et al., [12] who indicated higher concentration of this metal in tumor than in healthy tissues. Additionally, Wurzelmann [13] confirmed that Fe caused higher risk of large intestine cancer especially in women. Taking into consideration the relationship between mercury and its influence on carcinogenesis, it is proved that only organic form of this metal can cause stomach cancer [14]. Our analysis also points out such a connection, because we detected the higher level of Hg in stomach tumor. However, this explanation cannot be used in case of large intestine cancer.

CONCLUSION

The results suggest that some types of cancerous tissues may accumulate toxic elements more effectively and that biogenic elements concentration is disturbed. The most important is to recognize if these processes are the reason of the effect of cancerous processes.

REFERENCES

[1] WRONKOWSKI, Z.: Epidemiologia nowotworów złośliwych przewodu pokarmowego;15-77. In: KRAWCZYK, M.: Nowotwory przewodu pokarmowego. Warszawa. Wydawnictwo Lekarskie PZWL, 2001.

[2] TANAKA, T.: Effect of diet on human carcinogenesis. Critical Reviews in Oncology/ Hematology, 1997, 25, 73-95.

[3] VAN HALTEREN, H.K., TAAL, B.G., VAN TINTEREN, H., VAN LEEUWEN, F.E.: Risk Factors for the Development of Oesophageal Cancer as a Second Primary Tumor. European Journal of Cancer, 1995, 11, 1836-1839.

[4] WARNAKULASURIYA, S.: Global epidemiology of oral and oropharyngeal cancer. Oral Oncology, 2009, 45, 309-316.

[5] KOTYNIA, J.: Rak żołądka; 49-55. In: MAŁECKA-PANAS, E.: Zarys gastroenterologii. Łódź. Wydawnictwo Uniwersytetu Medycznego, 2006.

[6] KEY, T.J., ALLEN, N.E., SPENCER, E.A., TRAVIS, R.C.: The effect of diet on risk of cancer. Lancet, 2002, 360, 861-868.

[7] FELIPPE, A., VICENTE, R., VILLALONGA, N., ROURA-FERRER, M., MARTINEZ-MÁRMOL, R., SOLÉ, L., FERRERES, J.C., CONDOM, E.: Potassium channels: New targets in cancer therapy. Cancer Detection and Prevention, 2006, 30, 375-385.

[8] YANG, CH.Y., CHENG, M.F., TSAI, S.S., HSIEH, Y.L.: Calcium, Magnesium, and Nitrate in Drinking Water and Gastric Cancer Mortality, 1998, 89, 124-130.

[9] YANG, CH.Y., CHIU, H.F., CHIU, J.F., TSAI, S.S., CHENG, M.F.: Calcium and Magnesium in Drinking Water and Risk of Death from Colon Cancer, 1997, 88, 928-933.

[10] BENNETT, M., POCHAPIN M. D.: Rak jelita grubego. Poznań. Dom Wydawniczy REBIS, 2004; 65-170.

[11] REDDY, S.B., CHARLES, M.J., NAGA RAJU, G.J., REDDY, B.S., REDDY, T.S., LAKSHMI, P.V.B.R., VIJAYAN, V.: Trace Elemental Analysis of Cancer-Afflicted Intestine by PIXE Technique. Biological Trace Element Research, 2004, 265-281.

[12] RUDOLF, E., JOHN, S., BRIATKA, T., ČERVINKA, M.: Toxicity of increased intracellular zinc in colon cancer cells. Abstracts/Toxicology Letters, 2010, 37-351

[13] WURZELMANN, J.I.: Cancer Epidemiology. Biomarkers Prevention, 1996, 5, 503.

[14] YORIFUJI, T., TSUDA, T., KAWAKAMI, N.: Age standardized cancer mortality ratios in areas heavily exposed to methyl mercury. International Archives Occupational Environmental Health, 2007, 80, 679-688.