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Research Article

Selected Trace Elements and Heavy Metals in the Serum of Postoperative Gastric Cancer Patients and Their Relationship to CEA

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I N F O

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A B S T R A C T

Introduction: Gastric cancer (GC) is the second and fourth most prevalent cancer in men and women, respectively, and is one of the leading causes of cancer death worldwide. Many studies have shown that heavy metal exposure and trace element levels in the body are the most critical etiologies for cancer development. As a result, the goal of our research was to assess the imbalances in the serum concentrations of selected elements (Cu, Co, Se, Ni, Cd, and Pb) in post-operative GC patients against healthy participants/ controls.

Methods: The metal levels were determined using a nitric acid/perchloric acid-based wet digestion technique and flame atomic absorption spectrometry, Serum levels of CEA were measured using a two-site immunoenzymometric assay, which is performed entirely in the AIA-PACK SLa test cups.

Results: Pb, Cd, and Ni concentrations were found to be significantly higher in the blood of GC patients than in the blood of controls, but Cu and Co levels were significantly lower in the blood of GC patients than in the blood of controls. In the blood of post-operative GC patients, correlation analysis revealed a positive association between CEA-Cd, CEA-Pb, and CEA-Ni, while the correlation was negative for CEA-Cu. These findings were statistically significant ($p < 0.05$).

Conclusion: According to our findings, low Co and Se levels, as well as high Pb and Cd levels, may have a role in the development of stomach cancer.

Keywords: Gastric Cancer, Trace Elements, Heavy Metals, CEA

Introduction

Gastric cancer (GC) is one of the top causes of cancer death worldwide, with men and women suffering from the second and fourth most prevalent cancers, respectively.[30] Very few trace elements, which are sufficient for the body, constitute less than 0.02% of the total body weight.[11] People are constantly exposed to a large number of toxic elements that are dispersed in nature. Lead, cadmium, toxic trace elements, show toxic effects for people even at a low level.[21,25] Trace elements (TEs) have an important part in cell stability, enzymatic, and hormonal functions, as well as reducing the harmful effects of other TEs including aluminium (Al) and lead (Pb).[3,28] Superoxide dismutase (SOD), glutathione reductase, glutathione peroxidase, and lipid peroxidation products were found to be linked with TEs concentrations in malignant tissues.[13,19]

However, there is insufficient information on the amounts of TEs in GC patients after surgery. On the other hand, numerous earlier investigations have measured TEs using tissues rather than serum. Cu, Se, Ni, Pb, Co, and Cd levels in postoperative GC patients were investigated in this study. The levels of trace and heavy metals found in the patients' blood serums were compared to those found in healthy people. The goal of our research is to figure out how specific trace elements and heavy metals interact with GC.

Materials and Methods

This study was conducted in the main unit for Tumours Oncology/ Teaching Al-Habooby Hospital and specialist clinics in Nasiriyah city/ Iraq, during the period from January-2020 to January-2021. Thirty healthy people took part in the study (males and females) and 30 postoperative GC patients both two groups aged between (30-70). About 5 mL of blood from GC patients and controls was drawn and left to clot at room temperature in empty disposable tubes before being centrifuged at 3000 xg for 10 minutes to separate the serum samples, which were then separated and stored at (-20°C) until needed to test biochemical parameters. Serum levels of CEA were measured using a two-site immunoenzymometric assay, which is performed entirely in the AIA-PACK SLa test cups. Cu, Cd, Pb, Ni, Co, and Se were analysed using atomic absorption spectroscopy (Atomic Absorption Spectrometer AA500, PG Instruments, England) with acetylene-air as a flame and hollow cathode lamps as a radiation source.

Results

High levels (> 5 ng/mL) of CEA was found in (60%) of postoperative GC patients compared to healthy subjects (Table 1), we use the concentration (> 5 ng/mL) as a cutoff value, the increase was statistically significant ($p < 0.05$), on the other hand, the values of the trace elements that were tested Cu and Co were significantly ($p < 0.05$) low in GC patients group as compared to the healthy group, while the levels of the tested heavy metals (Cd, Ni and Pb) were significantly ($p < 0.05$) high in GC patients group as compared to the healthy group (Table 2 and Figure 1).

Correlation studies between CEA levels and studded elements in GC patients show a negative correlation among CEA-Se (Figure 2) and CEA-Co, (Figure 3), whereas the correlation was positive among CEA-Cd (Figure 4) and CEA-Pb (Figure 5).

Table 1.Total Mean Serum Levels of CEA in the Sera of Healthy People and People with GC

CEA	Groups (ng/mL)	No.	%	Mean ± SE
Control	< 5 ng/mL	30	100	2.32 ± 0.18
GC patients	> 5 ng/mL	18	60	17.97 ± 5.32
	< 5 ng/mL	12	40	2.54 ± 0.37
	Total	30	100	11.8 ± 3.45
df	89	Sig < 0.05	LSD	5.89

Table 2.Total Mean Serum Levels of Trace Elements and Heavy Metals in the Sera of Healthy People and People with GC

Groups	Copper levels (µg/l) (Mean ± SE)	Selenium Levels (µg/l) (Mean ± SE)	Cadmium Levels (µg/l) (Mean ± SE)	Nickel Levels (µg/l) (Mean ± SE)	Lead Levels (µg/l) (Mean ± SE)	Cobalt Levels (µg/l) (Mean ± SE)
Control	1162 ± 77.47	114.06 ± 2.81	145.2 ± 8.80	76.36 ± 0.83	158.73 ± 10.12	96.43 ± 3.66
GC patients	1088 ± 19.66	106.26 ± 3.26	280.73 ± 4.73	74.6 ± 2.35	186.23 ± 2.11	48.93 ± 2.5
LSD	210.43	5.26	42.93	2.58	17.82	6.9

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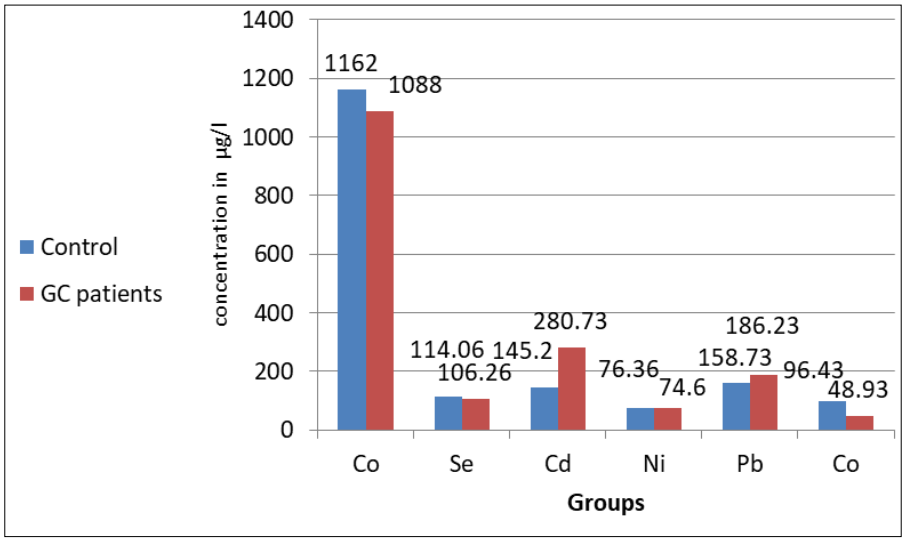

Figure 1.Total Mean Serum Levels of Trace Elements and Heavy Metals in the Sera of Healthy Subjects and GC Patients

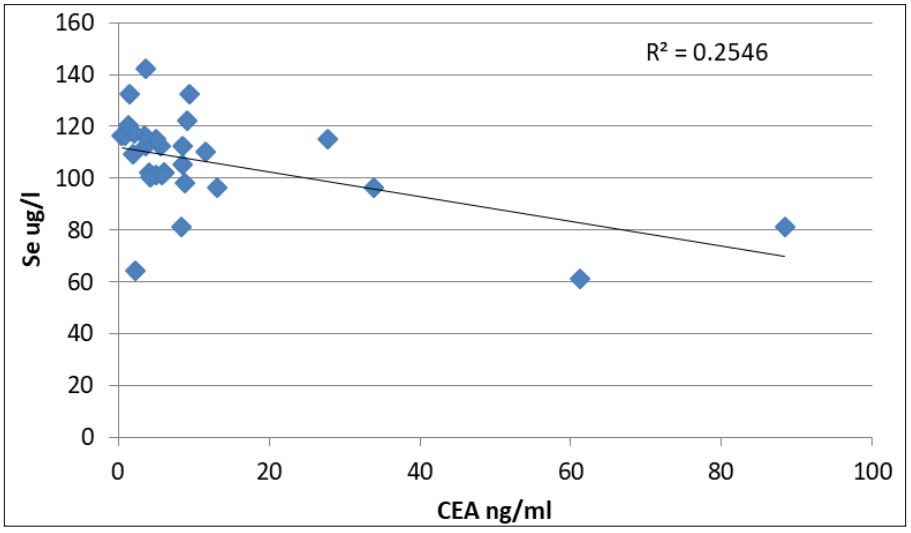

Figure 2.Correlation between CEA and Se in GC Patients Group

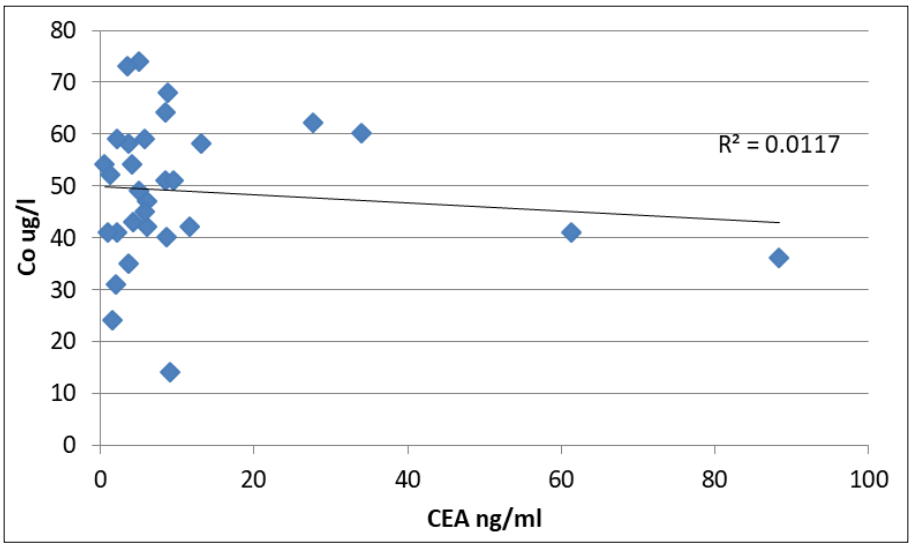

Figure 3.Correlation between CEA and Co in GC Patients Group

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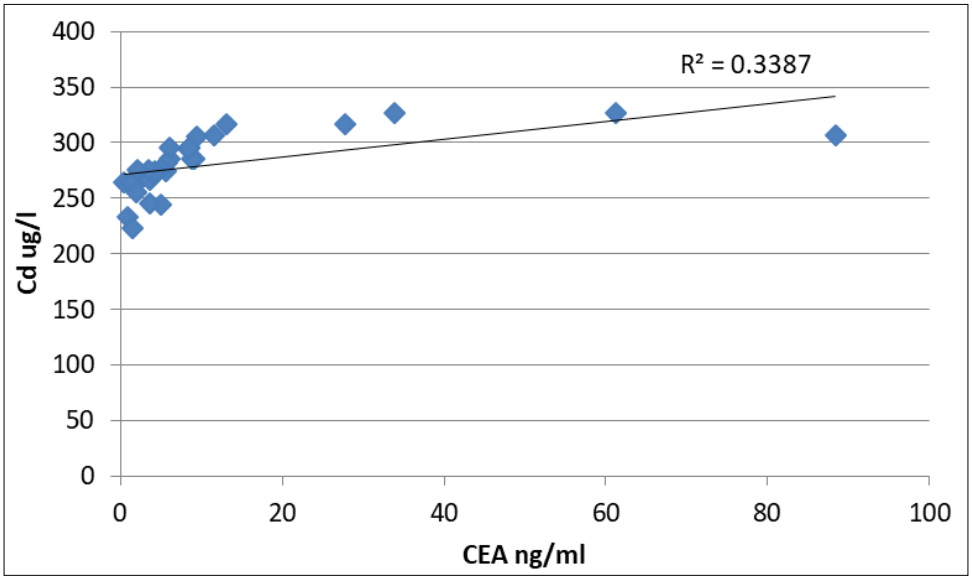

Figure 4.Correlation between CEA and Cd in GC Patients Group

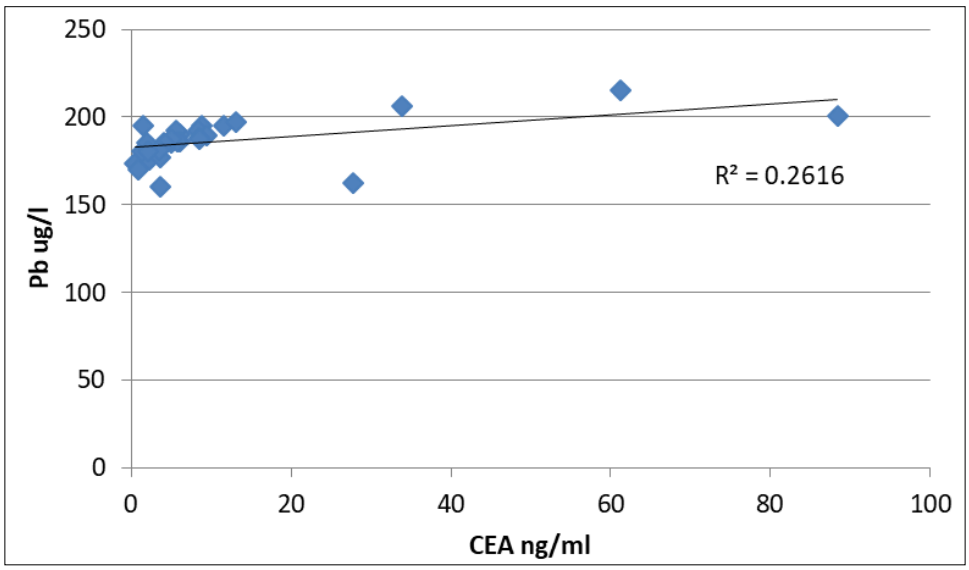

Figure 5.Correlation between CEA and Pb in GC Patients Group

Discussion

Tumour markers have been investigated as a technique of detecting recurrence of gastric cancer following surgery.[22,32] One of the most often utilised blood tumour markers in GC, carcinoembryonic antigen (CEA), plays a significant role in tumour metastasis and may be related to prognosis in GC.[12] The use of preoperative CEA levels as prognostic indicators in GC has been supported by several research,[16,34] Other investigations have found that postoperative CEA levels had prognostic relevance.[17] Post-operative CEA was discovered to be an independent predictor of recurrence, with a sensitivity and specificity of about 83 per cent and 95 per cent in detecting recurrent disease, respectively. The levels of elevated CEA were significantly higher in recurrent disease, and a high postoperative CEA was associated with an increased risk of recurrence and decreased survival.[5,7] Continuously elevated CEA levels after surgery may indicate inadequate resection or concealed metastases, and serial CEA level assessments after treatment may help detect recurring illness in colorectal cancer (CRC).[29]

More than 30 enzymes utilise copper as the main building block in the human body including ascorbate oxidase, ceruloplasmin, lysine oxidase, dopamine-hydroxylase, tyrosinase and cytochrome oxidase.[26] Our results show that there is no significant difference in Cu levels between GC patients group and control group, these results matched with the results of a study by Yang Y et al.[35] According to a review published in 2019, human colorectal cancer patients had lower serum concentrations of Cu.[6] Changes in trace element levels have an inverse association with numerous biological processes, and they may cause carcinogenesis. Furthermore, animal studies revealed that decreased Cu

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consumption is linked to the formation of 3,2'-dimethyl-4-aminobiphenyl (DMABP)-induced colon tumours in rats.[10]

Selenium plays a key role in a variety of metabolic pathways, and it can be found in a variety of forms. Immune regulation, oxidative damage avoidance, DNA damage repair, and apoptosis and cell cycle regulation are all anticarcinogenic mechanisms of Se.[21,36] Our study shows that Se levels were significantly ($p < 0.05$) low in GC group as compared to control group, these results are similar to a study on CRC.[4] Low serum levels of Se were also closely linked to the risk of CRC in a prior investigation.[18] A recent study suggests that lower levels of Se may play an important role in gastric cancer induction.[20]

Cadmium is an established toxic and carcinogenic metal.[24, 27] Our results show that Cd concentrations were significantly ($p < 0.05$) high in GC group as compared to control group. In a similar study by Demir D on lip and oral cavity cancers, it was found that the levels of Cd in the blood of the patients were higher than the healthy control group. The main sources of cadmium in our body are animal and plant food products.[26] The first discovering of carcinogenic activity of Cd was in animals and subsequently in humans.[15] Previous studies had suggested the possible mechanism of action of Cd via indirect processes or epigenetic changes that activates the oncogenes or suppresses apoptosis.[33] Cd appears to be linked to overall cancer mortality in both men and women, according to epidemiological studies. Cd raises the risk of pancreatic cancer, lung cancer, leukaemia, and non-Hodgkin lymphoma in males; it raises the risk of leukaemia, lung cancer, ovarian, and uterine cancer in women, but the risk of cancer is lower than in men.[1]

Nickel compounds and nickel are suspected of being carcinogenic.[14] Our results show non-significant differences in Ni levels in GC group as compared to control group.

Our results show that Pb concentration was significantly ($p < 0.05$) high in GC group as compared to control group. These findings are in disagreement with the results of the study of Afzal A et al.[2] Similar results by Çobanoğlu U, et al., who found that the concentration of Pb in the serum of lung cancer patients was significantly higher than the healthy control group.[9] Pb concentrations in cancerous tissues of colon cancer patients were much greater than in healthy non-cancerous tissues, according to Sohrabi M et al.[31] According to a study by Lustberg M et al. those with high levels of lead have a higher risk of cancer-related death from non-lung cancer and lung cancer.[23]

Our study shows a significant decrease in the levels of Cobalt in the patients group in comparison with the control group ($p < 0.05$). A previous study on thyroid cancer found that the levels of Cobalt were significantly lower ($p < 0.05$) in the blood of the patients compared with the control group.[8] Cobalt is an important component in vitamin B12 and essential for human well-being.[26]

Conclusion

Finally, nutritional and environmental variables play an essential influence in cancer development. As a result, heavy metals and trace elements may play a role in the prognosis of complicated diseases like stomach cancer. According to our findings, low Co and Se levels, as well as high Pb and Cd levels, may have a role in the development of stomach cancer.

Conflict of Interest: None

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