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Research Paper

Comparison of Copper and Zinc Levels in Blood Between Normal and Breast Cancer Patients

MEDICAL SCIENCE

KEYWORDS : Breast cancer, zinc level in breast cancer, copper level in breast cancer

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ABSTRACT

The level of heavy metals like copper and zinc in the serum of breast cancer patients were determined to find their importance in the prognosis of cancer. A total of 42 cancer patients and 30 normal patients were included in the study. The level of copper and zinc were determined in the serum using inductively coupled plasma mass spectrophotometry. Results showed the level of copper is significant higher (p<0.001) in breast cancer patients whereas level of zinc is significantly lower (p<0.001) among breast cancer patients as compared to controls. This indicates a strong correlation between serum levels of copper and zinc and carcinoma breast, thus indicating the role of trace elements in pathogenesis of malignancy.

Table 1 : Comparison of Copper and Zinc Levels

	CASES	CONTROLS	p value
COPPER	158.8±15.40	124.41±17.32	<0.001
ZINC	54.54±8.20	84.68±9.72	<0.001

Table 2 : Age Distribution

Age in years	Cases (n=42) No	%	Controls(n=30) No	%
<45	14	33.3	12	40
≥45	28	66.7	18	60

INTRODUCTION

It has become well established that many trace elements play an essential role in a number of biological processes through their action as activators or inhibitors of enzymatic reactions by competing with other elements and proteins for binding sites, by influencing the permeability of cell membranes, or through other mechanisms. It is therefore reasonable to assume that these trace minerals would exert action, directly or indirectly, on the carcinogenic process.[1,3,4]

New analytical techniques, such as neutron activation and energy dispersive X-ray fluorescence (EDXRF)[2] make possible the simultaneous determination of ultra trace quantities of elements in human tissues and body fluids. By using such techniques, it is possible to determine whether the simultaneous monitoring of the less abundant trace metals has diagnostic or prognostic significance.

Zinc is essential for growth and cancer is characterized by uncontrolled growth. Zinc accumulation suggests an involvement of zinc in breast tumorigenesis. Zinc is important to cell proliferation; however, Sukumar et al[5] and Lee et al[8] reported that it accumulates in mammary tumors and supports tumor growth.

Copper plays an essential role in promoting angiogenesis. Tumors that exhibit increased metastatic potential. Copper stimulates the proliferation and migration of endothelial cells and is required for the secretion of several angiogenic factors by tumour cells. Serum copper levels are upregulated in many human tumours and correlate with tumour burden and prognosis.

MATERIAL AND METHODS

After approval from institutional review board, a total of 42 breast cancer patients and 30 healthy volunteers were recruited from patients coming to surgery opd at S.N.Medical College, Agra. This study excluded patients with diabetes mellitus, hypertension , jaundice, pregnant patients, patients who are breast feeding and those taking hormonal therapy.

For measurement of trace element level, blood was collected.10 ml of venous blood was obtained from antecubital fossa.The blood was allowed to clot, retracted and centrifuged. From the serum, levels of copper and zinc were measured using inductively coupled plasma mass spectrophotometry.

RESULTS

The mean level of copper among cases and controls were 158.8±15.40 and 124.41±17.32 µg/dL respectively. The reference range for normal copper level is 70-140 µg/dL. The level of copper was significantly higher(p<0.001) among breast cancer patients as compared to controls.

The reference range for normal level of zinc in adult female was 62-256 µg/dL . The level of zinc was significantly lower (p<0.001) among cases (54.54±8.20) than controls(84.68±9.72)

STATISTICAL ANALYSIS

Data was analysed using unpaired t test and chi square test and MS Excel analyse statistical software.

DISCUSSION

Metals and metal compounds interfere with breast cancer in multiple ways. On one side, they are an important risk factor for the development of breast cancer, while on the other hand their cytotoxicity might have also beneficial effects inducing apoptosis and cytotoxicity in breast cancer cells. There is a need to understand, under which circumstances specifically cancer cells could be targeted by metals and their compounds.[15]

It has been reported that a decline in the cell mediated immunity predisposes to oncogenesis, and a close association has been found between immune responses and macro- or micronutrient status.[10,11] This implied that it may be possible to monitor the prognosis of cancers using the levels of trace metal.

We conducted a study consisting of 42 histopathologically proven breast cancer patients, and 32 apparently normal sub-

jects as control. Overall, higher levels of serum copper ($p<0.001$) lower level of serum zinc ($p<0.001$) were observed in these subjects(table 1).

As per our study no significant differences were observed for the ages of the breast cancer patients and healthy volunteers(table 2).

A physiological feature of many tumor tissues and cells is the tendency to accumulate high concentrations of copper. Copper, but not other trace metals, is required for angiogenesis. Angiogenesis, the growth of a tumor blood supply, is essential for tumor growth, invasion, and metastasis. It has been shown that tumors, without a blood supply, do not grow larger than 1 to 2 mm^3. Molecular processes of angiogenesis that require copper as an essential cofactor include stimulation of endothelial growth by tumor cytokine production (i.e., vascular endothelial growth factor), degradation of extracellular matrix proteins by metalloproteinases, and migration of endothelial cells mediated by integrins. Consistently high levels of copper have been found in many types of human cancers, including breast cancer.[6,7]

Similar result was observed in our study as significantly high levels of serum copper was associated with breast cancer patients ($p<0.001$).

Another similar study reported a significant increase in the mean total serum copper levels in all patient groups with carcinoma breast [16]

In another study it has been suggested that the copper ions and copper complexes react with hydrogen peroxide to form hydroxyl radicals that cause damage to protein, RNA and DNA. The damages are not repairable by cellular mechanisms thus initiating the malignant process. This study showed the dual role of copper. [12]

As literature suggests that Zinc is a micronutrient, which is essential for human health, playing role as a cofactor of enzymes such as dehydrogenases, peptidases and component of zinc finger domains. Zn is required for growth and, as a component of the Zn finger proteins; it plays a pivotal role in controlling of cell division and oncogenic activation.[9] There is also some evidence for an inverse association between Zn and breast cancer.[13]

Our study also shows serum zinc levels were significantly low in the cases ($p<0.001$) as compared to controls

A similar observation was made in a study which reported that analysis of serum zinc concentration revealed tendency to increased risk of breast cancer with low zinc levels.[17]

Another study reported that the level of copper and zinc were significantly lower in breast carcinoma patients as compared to their controls.[14]

CONCLUSION

Hence we conclude that low level of zinc and high level of copper in plasma is significantly associated with breast cancer.

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