



Estimation of Serum Levels of Calcium and Inorganic Phosphorus in Breast Cancer Patients

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Abstract

Breast cancer is a type of cancer which is developed by the formation of a tumor on the breast. This tumor invades and causes different electrolyte imbalance. Present study was designed to measure the serum calcium and inorganic phosphorous levels and to check the frequency of hypercalcemia and hypophosphatemia in breast cancer patients. Serum calcium and phosphorous levels of fifty breast cancer women of 18-70 years of age group and fifty healthy women of same age group was measured by using semi automated chemistry analyzer (Humalyzer 3000, Human, Germany). Significant variation in these levels was observed. The mean calcium value in BC patients was higher 9.398 mg/dL as compared to controls which was 8.694 mg/dL. Whereas the mean value of inorganic phosphorus level was lower 4.060 mg/dl in BC patients as compared to controls having 4.456 mg/dL. In this study the frequency of hypercalcemia in BC patients was 10% i.e. only 5 out of 10 BC patients were suffering from hypercalcemia. Whereas the frequency of hypophosphatemia in this study was only 2 % i.e. only 1 out of 50 patients was suffering from hypophosphatemia. Thus it is concluded that there is a significant change in serum calcium and Pi levels in BC patients as the disease progresses. So, this study will be helpful for the clinicians to maintain serum calcium and phosphorous levels in BC patients and also preventing them from further complications.

Keywords: Breast cancer, Serum, Electrolytes, Calcium, Phosphorus,

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1. Introduction

Breast cancer (BC) initiate from tissues of breast usually from the inner linings of the milk duct or from the lobules which supply milk to the duct (Sariego, 2010). Cancers in ducts is called ductal carcinoma and that in lobules is called lobular carcinoma. This cancer occurs in humans and different other mammals. Out of which majority is found in women and in some rare cases it has been observed in males. Sign and symptoms include the formation of lump on the breast (Male breast cancer. Available online updates at <http://www.nlm.nih.gov/medlineplus/malebreastcancer.html>). According to the condition of the disease treatment is recommended that may include surgery, different medications as hormonal therapy and chemotherapy. Surgeries are of different types depending on the stage of the tumor and cancer (Florescu *et al.*, 2011). Worldwide 22.9% of all cancers in women account breast cancer (excluding skin cancer). More than 0.4 million deaths worldwide took place due to breast cancer in 2008 which is about 13.7% of cancer deaths in females Cancer Survival in England, patient diagnosed, (Available online with updates at <http://www.ons.gov.uk/ons/publications/referencetables.html?edition=tcM%3A77-216670>). An important risk factor of breast cancer is increase in age (Reeder and Vogel, 2008). Other risk factor is the lack of breast feeding, the longer the women feed on breast milk less is the risk of disease and more she is protected. This is the reason why BC is more common in developed countries (Yang and Jacobsen, 2002).

Table 1: Demographic data obtained from females having breast cancer.

Age	Frequency of patients	%
18-30	5	10
31-50	37	74
51-70	8	16
Total	50	100
Dietary intake		
	Frequency of patients	%

Vegetarian	17	34
Non-Vegetarian	10	20
Balance diet	23	46
Total	50	100
Family History		
Family History	Frequency of patients	%
Yes	7	14
No	43	86
Total	50	100
Symptoms		
Symptoms	Frequency of patients	%
Difficulty in urination		
Yes	1	2
No	49	98
Total	50	100
Headache		
Yes	3	6
No	47	94
Total	50	100
Fatigue and weakness		
Yes	4	8
No	46	92
Total	50	100
Chest pain		
Yes	18	32
No	32	64
Total	50	100
Nausea and vomiting		
Yes	5	10
No	45	90
Total	50	100
Edema feet		
Yes	4	8
No	46	92
Total	50	100
Swelling in breast or armpits		
Yes	8	16
No	42	84
Total	50	100
Itching on tumor		
Yes	4	6
No	46	92
Total	50	100
Nipple discharge includes bleeding		
Yes	6	12
No	44	88
Total	50	100

Tobacco smoking also increased the risk to about 35% -50% (Johnson *et al.*, 2009). BC is also related to diet, increased intake of fat diets, alcohol consumption, obesity and height can also be the risk factor (Boffetta *et al.*, 2006). Main sites of metastasis of are bone, brain, liver and lungs Metastatic Cancer (<http://www.cancer.gov/cancertopics/factsheet/SitesTypes/metastatic>). Most of the people suffering from breast cancer also suffer secondarily from hypercalcemia (increase in calcium level) because tumor invades inside the bones and causes osteolysis (break down of bones and leakage of ions from it) as a result calcium and phosphorous leaks out of bones in serum, and in results serum calcium level rises (<http://center4research.org/medical-care-for-adults/hormone-therapy/hormone-therapy-and-menopause/>).

Parathyroid hormone (PTH) is released by 4 parathyroid glands and is used to balances the calcium and inorganic phosphorous (Pi) level in the blood. If these electrolytes remain in blood for a long time at higher concentration they cause stiffening of muscles and other body organs or tissues. When the calcium level decreases in blood, PTH brings it back to normal by carrying calcium from bones and by absorbing it from the small intestine. The increase in PTH also causes renal damage or failure, as more phosphorous shall be excreted in the urine causing hypophosphatemia. Symptoms of hypophosphatemia are neurological and muscle dysfunction, due to short of ATP other complications also took place which includes distraction of blood cells and muscles. It is also very important factor in blood clotting and without blood cannot clot. Calcium also offers the electrical impulse that permits the transmission of signals which than contracts the muscles (<http://www.parathyroid-gland.com>).

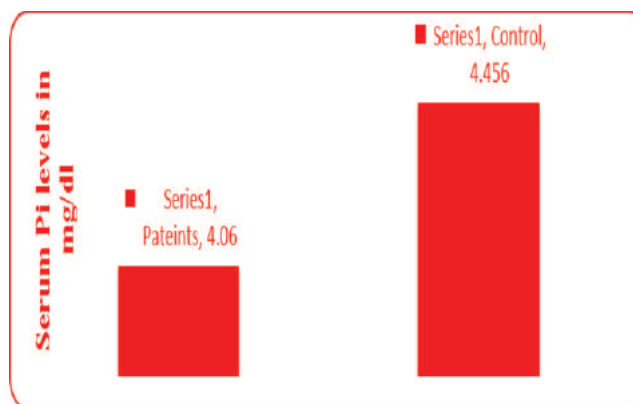


Fig. 1 Fig. 2. Comparison of serum inorganic phosphorus level in BC patients and controls.

As the breast cancer females suffers from hypophosphatemia (low levels of phosphorus) so they are recommended to intake food which is rich in phosphorus which will than try to overcome this deficiency of phosphorus. Foods that are rich in phosphorus are protein foods which include milk, meat and soya characteristically. But if a female has developed hypercalcemia then milk is not a good choice of food (<http://www.parathyroid-gland.com>). Normal levels of serum calcium are 8.9-10.1 mg/dL and in case of hypercalcemia level of calcium should be greater than 10.3 mg/dL. Normal levels of serum Pi are 3.4- 4.5 mg/dL and in hypophosphatemia it is less than 2.5 mg/dL.

2. Material and Methods

This study was carried out at Medical out door of Institute of Nuclear Medicine and Oncology Lahore (INMOL). The study design adopted was Cross – sectional analytical. Fifty diagnosed and pre-treated patients of Breast cancer between the ages of 18-70 years were included and fifty normal participants (The people having Cerebrovascular, Cardiovascular disease and Dialysis were excluded) between the same age group were selected as a control. Age was categorized into three groups, 18- 30 year as group 1, group 2 of 31-50 years, and group 3 of 51-70 years. Patients having breast cancer visiting Medical out door of INMOL were recruited for this study. Consents were taken from each subject after the procedures of the study were clearly explained to them. A questionnaire was made before the study started. Each questionnaire was filled from each subject before blood collection. Five mL of venous blood was drawn from breast cancer patients using sterile, disposable syringes. It was then transferred to labeled gel vials and allowed to clot for separation of serum. The serum was transferred to clean falcon tubes and centrifuged at 4000 revolutions per minute (rpm) for 5 minutes at temperature 37 °C to separate it from red blood cells, if any. Finally the centrifuged samples were poured into microcentrifuge tubes. After isolation of serum the serum calcium and phosphorus levels were estimated by using Semi automated chemistry analyzer (Humalyzer 3000, Human, Germany) by calcium kit and phosphorus kit.

3. Results

Age was categorized into three groups, 18- 30 year as group 1, group 2 of 31-50 years, and group 3 of 51-70 years. Results showed that Group 1 contained 10%, group 2 contained 74% and group 3 contained 16 % of breast cancer patients (Table 1). In the study group, 46% were taking balance diet (eating vegetables, meat and dairy products), 34 % were non vegetarians while the remaining 20% were vegetarians (Table 1). Results of the study showed that 86 % of people did have any family history of disease and were new cases where as 14% of the patients showed family history of the disease and were 1st degree relative of the patients. Table 1 showed the percentage of signs and symptoms observed in the patients.

In the BC patients, the serum calcium level varied from 8.2 to 9.6 mg/dL. In the controls, the serum calcium levels varied from 8.2 to 8.7 mg/dL. Mean \pm SD levels of serum calcium were low in BC patients (± 0.6265) than the calcium levels (± 0.6400) in controls (Figure 1).

In the BC patients, the serum phosphorus levels varied from 3.8 to 4.1 mg/dL. In the controls, the serum phosphorus levels varied from 3.8 to 4.5 mg/dL. Mean \pm SD levels of serum phosphorus was higher in BC patients (4.06 ± 0.6590) than the phosphorus levels (4.456 ± 0.6538) in controls Figure 2.

In the BC patients mostly hypercalcemia is observed due to tumor invasion in bones and leakage of calcium out of the bones in serum. In the present study the frequency of

Table 1. Calcium and phosphate level of breast cancer patients

Calcium level (mg/dL) in BC patients who had developed hypercalcemia	Frequency of hypercalcemia in patients	Percentage
10.3	1	2
10.4	2	4
10.5	1	2
10.9	1	2
Total	50	100
Pi levels (mg/dL) in BC patient who had developed hypophosphatemia	Frequency of hypophosphatemia in patients	%age
2.4	1	2
Total	50	100

hypercalcemia in Pakistani breast cancer patient was 10 % (Table 4). more Pi is excreted from the kidney which leads to hypophosphatemia. In the present study the frequency of hypophosphatemia in Pakistani breast cancer patient was 2 % (Table 4).

Discussion

Breast cancer (BC) is a type of cancer which originates from tissues of breast. In this disease tumor in breast invades insides bones and causes osteolysis. Calcium and inorganic phosphorus leaks out from defected bones and their level increases in serum. High level of calcium causes hypercalcemia and more Pi is excreted by the kidney which will lead to hypophosphatemia. In this study total 50 patients were selected. Patient's age group varied between 18 to 70 years. Results of the study showed that 10% of

patients were between age 18-30 years, 74% were between 31-50 years of age and 16% were between 51-70 years. Result showed that highest percentage of patients observed were between the age of 31-50 years. Results also show the change in serum calcium and inorganic phosphorus levels in BC patients and were compared with the result of 50 healthy individuals with matched age groups.

In this study, dietary pattern of 50 BC patients was studied which showed 46% are taking balanced diet (eating both vegetables, meat and dairy products), 34% are non-vegetarians, while the remaining 20% were vegetarians. In this study family history of the patients were also checked and 14% of the patients showed family history of BC, which coincides with the previous study (Gaffield *et al.*, 2009). As the kidney have to excrete more Pi, so in some cases it was observed that BC leads to renal failure and patients have difficulty in urination (<http://www.parathyroid-gland.com>). But in this study only 2% patients have difficulty in urination.

In this study common signs and symptoms reported were that 6% patients had headache, 8% having fatigue and weakness, 36% were suffering from chest pain, 10% having nausea and vomiting, 8% were having edema feet, 16% were having swelling in breast or armpits, 8% were having itching on tumor and 12% had nipple discharge which includes bleeding. In the previous study same similar symptoms were examined in BC patients (Dafnis and Laski, 1993).

The result of present study showed that serum calcium level in BC patients was higher 9.398 mg/dL as compared to the control subjects which was 8.694 mg/dL. This shows that at first the calcium level was normal, but it keeps on increasing as the disease progressed (Hassan *et al.*, 2012), as the tumor size increases in size and invades insides bone it will increase the calcium level. Patients taken were pre- treated and were on their initial stages of disease, the mean calcium level in BC patients fell in normal calcium level range but still higher as compared to the normal controls, and this coincides with the previous studies (Taube *et al.*, 1994). This means that as the disease will progresses the calcium level shall also increases. So the study coincides with the previous study that BC leads to hypercalcemia in later stages (Martin *et al.*, 2010).

In present study the serum phosphorus level changes in breast cancer patients such as mean value of inorganic phosphorus level was lower in BC patients as compared to controls subjects, having 4.456 mg/dL but was normal. Same is the case over here as was with calcium, as the disease progresses it will leads to hypophosphatemia. So the result agreed with the result of previous study that the mean phosphorus level was normal in BC patients (Taube *et al.*, 1994). But still decline is observed in Pi levels of BC patients as compared to controls, which matched with the result of previous study (Nathaniel *et al.*, 2010).

According to this present study the frequency of hypercalcemia was 10% such that 5 out of 50 patients have lead to hypercalcemia. This demonstrates that as the disease will move on it will secondarily causes hypercalcemia. This result of the study coincides with the previous studies that 26.4% patients who had superior stage cancers had calm hypercalcemia (10.5-11.9 mg/dL), 55.5% had temperate (12-12.9 mg/dL), and 18.2% rigorous hypercalcemia (13-13.9; 14-16 mg/dL) (Martin *et al.*, 2010).

According to the present study the frequency of hypophosphatemia in BC patients was only 2% such that 1 out of 50 patients. This shows that kidney will excrete excess of phosphorus when the disease has progressed and had cause more phosphorus level in serum. So the present study matched with the previous study results that Pi levels in Bc patients were 0.94 ± 0.36 (mmol /L) as compared to control group having Pi level of 1.48 ± 0.62 (Nathaniel *et al.*, 2010).

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Conflict of interest

Authors have no conflict of interest.

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