Correlation Between Blood Albumin Levels and Blood Calcium Levels in Breast Cancer Patients

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Abstract. Breast cancer is the most common type of cancer in women and is the main cause of fatalities. In breast cancer patients, serum albumin levels are often decreased due to cancer therapy, malnutrition, and the systemic inflammatory response to the tumor. Most of the calcium in the blood circulation is bound to protein. If plasma protein concentrations increase (as in dehydration), protein-bound calcium and total serum calcium increase. This study aims to analyze the correlation between blood albumin levels and blood calcium levels in individuals with breast cancer. The research method used was analytical observational with a cross-sectional study design. A total of 36 patients diagnosed with breast cancer were examined at RSUD Prof. DR. WZ Johannes for the period January to March 2023 was used as a sample in this study using a purposive sampling method approach. Average The albumin level in the respondents' blood was 3.64 g/dL and the average calcium level in the respondents' blood was 2.53 mmol/L. The results of the Pearson Correlation parametric test showed a significance value of p = 0.022 (p-value <0.05) with r = 0.380. So the conclusions that can be drawn from this study are there is a significant relationship between blood albumin levels and blood calcium levels in breast cancer patients.

Keywords: Breast Cancer, Albumin, Calcium.

1 Background

Breast cancer is a type of cancer that often occurs in women and is the main cause of death. Based on 2020 WHO GLOBOCAN data, it was reported that of the 396,914 total new cancer cases found in Indonesia, 68,858 new cases (16.6%) of the total were diagnosed with breast cancer, with more than 22,000 people, the number of deaths reported was (GLOBOCAN ,2020). Based on year data in 2018, the total number of patients undergoing chemotherapy at RSUD Prof. DR. W.Z. Johannes Kupang is 603 cases and is dominated by breast cancer with 166 cases and increased in 2019 to 684 cases, with 278 cases being undergoing chemotherapy (Anastasia Paji et al., 2021).

In breast cancer patients, serum albumin levels are often decreased, which is caused by malnutrition and a systematic inflammatory response to the tumor. In addition, in cancer, hypoalbuminemia is also caused by albumin synthesis which is inhibited by tumor necrosis factor 3 and interleukin-6 which occurs in the initial reaction of the tumor (Maruti et al., 2015). As a result, hypoalbuminemia can lead to hypocalcemia (Yuliana et al., 2020). If plasma protein concentration increases (as for example in dehydration), protein-bound calcium and total serum calcium increase. Under conditions

of reduced plasma protein (eg, liver disease, nephrotic syndrome or malnutrition), the concentration of protein-bound calcium is reduced, thereby reducing the total calcium level, although ionized calcium is maintained within the reference range of (Baynes and Dominiczak, 2014).

Levels of albumin and calcium in the blood need to be maintained, especially in breast cancer sufferers. Previous studies have suggested that albumin is an important determinant of survival in breast, colorectal, lung, oral, and gastric cancers (Surya et al., 2016). Meanwhile, other studies have found that higher serum calcium contributes to a lower risk of breast cancer, especially among women aged fifty and older (Wulaningsih et al., 2016).

Correlation of albumin levels in the blood with calcium levels in the blood in breast cancer patients at RSUD Prof. DR. WZ Johannes Kupang is considered important for research considering the large number of breast cancer cases in RSUD Prof DR WZ Johannes Kupang and the correlation between albumin levels in the blood and calcium levels in the blood in breast cancer patients is suspected.

2 Research Methods

This study used an analytic observational approach with a cross-sectional study design. This research was conducted at RSUD Prof DR. WZ Johannes Kupang, East Nusa Tenggara. This research was conducted from November 2022 to March 2023.

Patients who met the inclusion and exclusion criteria and had been diagnosed with breast cancer who were treated as inpatients or outpatients at RSUD Prof. DR. WZ Johannes Kupang from January to March 2023 was sampled in this study. Purposive sampling is the technique used in this research sampling where samples that meet the inclusion and exclusion criteria are used as samples in this study.

3 Results and Discussion

3.1 Results

A total of 36 respondents who met the inclusion and exclusion criteria were willing to collaborate in this research. The general characteristics of respondents are shown in Fig. 1 and Fig. 2.

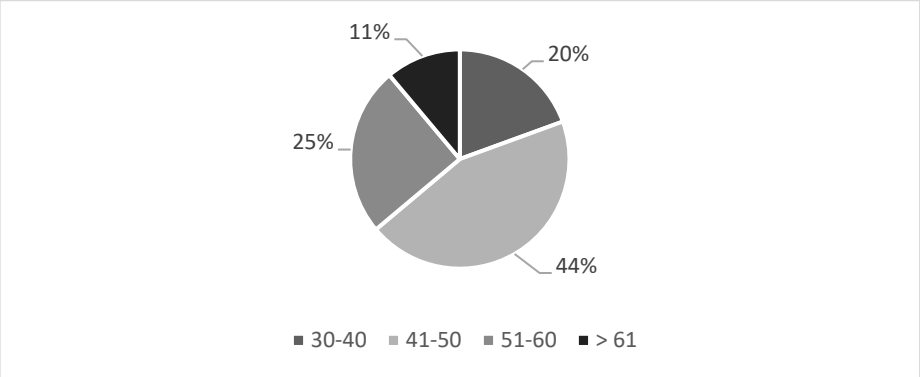

Fig. 1. Distribution of Respondents Based on Age (Years)

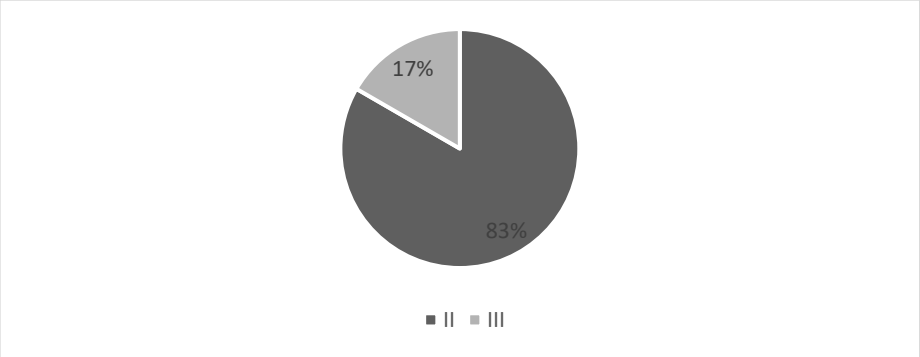

Fig. 2. Distribution of Respondents Based on Stadium

Table 1. Distribution of breast cancer patients based on blood albumin Levels (MEAN ± SD: 3.64 ± 0.59 g/dL)

Albumin Levels	Frequency (n)	Percentage (%)
Hypoalbuminemia	11	31
Normal	25	69
Hyperalbuminemia	0	0
Total	36	100

Table 2. Distribution of blood albumin level groups based on stadium

Breast Cancer Stage	Blood Albumin Level Group (g/dL)						Total	
	Hypoalbuminemia		Normal		Hyperalbuminemia			
	n	%	n	%	n	%	n	%
II	9	25	21	58	0	0	30	83
III	4	11	2	6	0	0	6	17
Total	13	36	23	64	0	0	36	100

Table 3. Distribution of breast cancer patients based on blood calcium levels (MEAN ± SD: 2.53 ± 0.19 mmol/L)

Albumin Levels	Frequency (n)	Percentage (%)
Hypocalcemia	2	6
Normal	27	75
Hypercalcemia	7	19
Total	36	100

Table 4. Distribution of blood calcium level groups based on stadium

Breast Cancer Stage	Blood Calcium Level Group (mmol/L)						Total	
	Hypocalcemia		Normal		Hypercalcemia			
	n	%	n	%	n	%	n	%
II	2	6	21	58	7	19	30	83
III	0	0	6	17	0	0	6	17
Total	2	6	27	75	7	19	36	100

After carrying out the Pearson correlation test, a p value of 0.02 ($p<0.05$) was obtained, meaning Ho was rejected while Ha was accepted so that it could be concluded that there was a significant relationship between albumin levels in the blood and calcium levels in the blood. Furthermore, the correlation coefficient value is positive, namely $r = 0.379$ with $\alpha = 0.05$, which means the strength of the relationship between the two variables is weak.

3.2 Discussion

The data obtained shows that the age range that dominates is the age group of 41-50 years, namely 44% of the total respondents and the least in the age group over 61 years, namely 11% of the total respondents. In a study conducted by Angahar regarding the epidemiological picture of breast cancer, risk factors, pathophysiology, and reduced risk of cancer, it was stated that the risk of developing breast cancer increased with age with a percentage of 1.5% at the age of 40 years, 3% at the age of 50 years, and more than 4% at age 70 years. This is thought to be directly related to hormonal changes in women in the elderly age group (Angahar, 2017).

In this study, most of the respondents were patients with stage 2 breast cancer, namely 83%, while the remaining respondents had stage 3 breast cancer, namely 17%. In contrast to the research conducted by Narisuari (2020) at Sanglah Hospital in Bali which examined the prevalence and description of the characteristics of breast cancer sufferers at Sanglah General Hospital, where the characteristics of the stage of breast cancer patients were more advanced stage patients (stage 3), namely 64% (Narisuari, 2020). This shows the level of awareness of breast cancer sufferers is starting to be high so that early detection of breast cancer can be known earlier.

In this study, the average albumin level in breast cancer patients was 3.64 ± 0.59 g/dL (within the normal range), where 69% of respondents had normal albumin levels and 31% of respondents had hypoalbuminemia. This finding is in line with research

conducted by Nabila in 2016 at Hospital dr. Zainoel Abidin who researched the correlation between albumin levels in the blood and grip muscle strength in cancer patients, where the average albumin level in breast cancer patients was also within normal limits, namely 3.55 ± 0.66 g/dL (Nabila et al., 2017). Increased or decreased albumin levels in the blood can be caused by various factors such as food intake, especially protein, and inflammation (Allen et al., 2015).

This study also looked at the distribution of blood albumin levels based on breast cancer stage where in stage 2 breast cancer there were 25% who had hypoalbuminemia and 11% in stage 3 who had hypoalbuminemia. In a study conducted by Wawolumaja et al (2019) who examined therapy in patients with stage IV breast cancer causing decreased CRP levels and increased albumin levels, stated that the incidence of hypoalbuminemia can be found in early stage cancer, but as the disease progresses, there is a marked decrease significant effect on blood albumin levels. This can then serve as an important indicator in predicting the development of malignancy (Wawolumaja et al., 2019).

In addition to albumin, blood calcium levels of respondents were also examined where the average blood calcium level was 2.53 ± 0.19 mmol/L with a distribution of 75% of respondents having normal blood calcium levels, then 19% of respondents with high calcium levels (hypercalcemia) and 6% of respondents with low blood calcium levels (hypocalcemia). This is consistent with the findings in a study conducted by Wulaningsih et al (2016) which examined serum calcium and breast cancer risk and found that 97.18% of breast cancer patient respondents had normal calcium levels (Wulaningsih et al., 2016). These findings indicate that most of the respondents who experienced breast cancer most have normal calcium levels because the body's absorption of calcium is still good. Calcium absorption is influenced by several factors including parathyroid hormone, estrogen, vitamin D intake, age and the presence of kidney abnormalities.

The distribution of blood calcium levels based on stage of the 36 breast cancer respondents found 6% hypocalcemia, 19% hypercalcemia, and most of them had normal calcium levels, namely 58% in stage 2. At stage 3, all of them had blood calcium levels within normal limits. In a study Sunn et al (2012) on serum calcium, tumor size, and hormone receptor status in women with untreated breast cancer found that women with breast cancer stage 3 breast cancer had an average blood calcium level lower than women with stage 2 breast cancer (Sunn et al., 2012).

In the statistical test of this study with a data ratio scale, the data distribution was normally distributed, therefore the Pearson Correlation parametric test was carried out, the p-value between blood albumin levels and blood calcium levels was 0.022 <0.05, meaning Ho was rejected while Ha was accepted, so the conclusion What can be drawn from this study is that there is a significant relationship between albumin levels in the blood and calcium levels in the blood in breast cancer patients. Furthermore, the value of the correlation coefficient is positive, namely $r = 0.380$ with $\alpha = 0.05$, which means that the strength of the relationship between the two variables is weak. Several studies regarding the relationship between the two variables in chronic kidney failure patients obtained different results. Research conducted by Parent (2022) found no significant relationship (p-value 0.587> 0.05) between the two variables, in

contrast to research conducted by Sihotang (2020) found a significant relationship between the two variables (p-value 0.001 <0.05) with a weak relationship strength (r=0.379) (Parent, 2022 and Sihotang 2020).

The body's serum albumin levels are influenced by various factors, such as malnutrition, stress, liver failure, aging, hydration conditions, and disease processes. In breast cancer, low serum albumin concentrations are caused by the production of cytokines such as interleukin (IL)-6, which regulates albumin production by hepatocytes (Fujii et al., 2020). Calcium exists in the blood circulation in three forms. Ionized calcium is the most important physiologically active form (50% of total calcium in the blood). Most of the remaining calcium is bound to proteins, especially negatively charged ones, namely albumin (40%), and the remainder is complexed into substances such as citrate and phosphate (10%). If plasma protein concentrations increase (as in dehydration), protein-bound calcium and total serum calcium increase. In conditions of reduced plasma protein (e.g. liver disease, nephrotic syndrome or malnutrition), the concentration of protein-bound calcium is reduced, which may decrease total calcium (Baynes and Dominiczak, 2014).

Research conducted by Parent (2022) and Sihotang (2020) examined the relationship between blood albumin levels and blood calcium levels but was not specific to breast cancer patients, so the results of this study are believed to provide additional new information for the management of breast cancer patients. This study has limitations, namely that it does not consider other factors that can influence blood calcium and blood albumin levels, such as the food intake consumed and the treatment carried out, so it is difficult to see the relationship between blood albumin levels and blood calcium levels directly. In addition, the researchers this time did not get breast cancer patients with an even distribution of stages due to time constraints so that the results of this study were not representative of all stages of breast cancer.

4 Conclusion and Recommendation

4.1 Conclusion

Based on the data that has been obtained and analyzed, several conclusions can be drawn, namely first, the average albumin level in the respondent's blood is 3.64 g/dL, second, the average calcium level in the respondent's blood is 2.53 mmol/L, and third, there is a significant relationship between blood albumin levels and blood calcium levels in breast cancer patients.

4.2 Recommendation

It is hoped that future researchers will be able to consider other variables that may play a role, such as food consumed and the type of chemotherapy used so as to obtain more detailed and accurate information. To the readers to always monitor blood albumin and blood calcium levels in breast cancer patients considering the importance of these two

parameters in knowing the patient's health condition, disease progression, and the effectiveness of the treatment given.

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