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A case-control study of the lipid profile of women with breast cancer

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Abstract

Purpose: Neoplastic diseases remain the second most common cause of death, behind cardiovascular diseases, and breast cancer is the leading cause of death among women worldwide. Increased incidence of neoplastic diseases is also known to be accompanied by lipid metabolism disorders.

Method: Blood samples for lipid profile testing were taken from the two studied groups, which comprised 110 women with breast cancer and 70 healthy women. Lipid profile testing was conducted on venous blood samples collected among both groups of women on an empty stomach. Statistical analyses were performed using the IBM SPSS Statistics 20 software package.

Results: A statistically significant ($p < 0.05$) majority of women with breast cancer had abnormal TC results (67.3%). A statistically significant ($p < 0.05$) majority of control group women (90.0%) had normal HDL-C results. More women with breast cancer (87.3%) had abnormal LDL-C results than healthy women (62.9%), which represented a statistically significant difference ($p < 0.05$).

Conclusions: Abnormal lipid profile significantly impacts breast cancer incidence. At the same time it is under influence of abnormal eating habits and low physical activity. Community and oncology nurses, having considerable knowledge about health and lifestyle of their patients, should be more involved in basic education to decrease cancer risk, especially by women with alarming LDL-C level.

Key words: breast cancer, lipid profile, TC, HDL, LDL, TG

Background

Each year, breast cancer claims the lives of millions of women worldwide, in both developed and developing countries [1, 2]. It is also second leading cause of cancer death among women [3, 4]. The proportion between breast cancer diagnosed in women and men is 100:1 [5]. The disease, which once affected mainly well-off white women in highly industrialised regions of North America and Western Europe, is nowadays diagnosed in all regions [1]. The highest incidence is currently observed in Western Europe, North America and the lowest in East Asia and Central Africa [6]. This is clearly related to the economic standing of these populations and access to screening services among women.

In countries of Western Europe 1 out of 8 women is diagnosed with this type of cancer [1]. The main reason for this is population ageing.

Epidemiological, clinical and laboratory studies have made it possible to identify a group of probable risk factors, which exhibit a positive correlation with the disease onset [7]. Population studies have demonstrated that early menarche, late menopause, childlessness and not breastfeeding are breast cancer risk factors [8, 9]. Increased incidence of neoplastic diseases is also known to be accompanied by lipid metabolism disorders [10]. The lipid profile is a group of values which includes: total cholesterol (TC), HDL cholesterol (HDL-C) – often referred to as "good", LDL cholesterol (LDL-C) – known as "bad", and triglycerides (TG).

Increased incidence of neoplastic diseases tends to be accompanied by lipid metabolism disorders [10]. Epidemiological studies [11, 12, 13, 14] indicate that the lipid profile is clearly a significant factor in the context of breast cancer. A connection between the levels of cholesterol and lipoproteins, and the risk of breast cancer has also been established [12, 14, 15, 16, 17]

This study uses factors from the first group in pathological tumour-node-metastasis (pTNM) staging, i.e. tumour (T), node (N), metastasis (M), and histologic grade (G), which possess a fully-documented clinical value and are widely applied in planning further treatment [18].

The objective of this study was to determine whether there was a correlation between the lipid profile and breast cancer.

METHODS

The study covered 180 women who did not receive any drugs or diseases affecting the lipid profile, were not pregnant and provided their consent to participate in the study. This included the group of women with breast cancer, which comprised 110 women who had no cancer history and were not previously treated for cancer and the control group of 70 healthy women at the Department of Surgical Oncology of St. John of Dukla Cancer Center in Lublin. Women in the study group were admitted to hospital for surgery and the control group was recruited from among patients with benign skin lesions removed for aesthetic reasons, women who came to visit those patients, and hospital staff, mainly nurses. The age of patients ranged from 28 to 86 in the breast cancer group and from 29 to 81 in the control group, and the average age in both groups was 55. All the necessary information about the studied

women was obtained from hospital documentation. The lipid profile was determined in the hospital laboratory. The desired value was assumed according to Lab Tests Online [19]: TC below 200 mg/dL (5.18 mmol/L), HDL-C above 50 mg/dL (1.3 mmol/L) in women, LDL-C below 100 mg/dL (2.59 mmol/L), TG below 150 mg/dL (1.70 mmol/L).

The data was then fed to IBM SPSS Statistics 20 software package, which was used to perform a series of statistical analyses. Due to the fact that the measured variables were nominal, a chi-square test was performed to verify the correlations between the dependent and independent variables. The results of the lipid profile were described on the basis of two values: normal and abnormal. The chi-square test was used to verify whether the normal or abnormal results of the lipid profile are affected by such factors as: the studied group, tumour size, the condition of the lymph nodes, type of carcinoma and tumour grade.

RESULTS

Changes in lipid profile among the studied women

A statistically significant ($p < 0.05$) majority of women with breast cancer (67.3%) had abnormal results, whereas most control group women (52.9%) had normal results for TC. More women with breast cancer (30.9%) had abnormal HDL-C results than healthy women (10%), a statistically significant difference ($p < 0.05$). Most control group women (90%) had normal HDL-C results. More women with breast cancer (87.3%) had abnormal LDL-C results than healthy women (62.9%), which represented a statistically significant difference ($p < 0.05$). For TG there were no statistically significant differences between the breast cancer group and control group.

The frequency analysis results and logistic regression coefficients are collectively presented in table 1.

Table 1. Abnormal values in the standard lipid profile among the studied women

		Group				Total		χ^2	p
		Breast cancer		controls					
		n	%	n	%	n	%		
TC	normal	36	32.7	37	52.9	73	40.6	7.19	0.007*
	abnormal	74	67.3	33	47.1	107	59.4		
HDL-C	normal	76	69.1	63	90.0	139	77.2	10.63	0.001*
	abnormal	34	30.9	7	10.0	41	22.8		
LDL-C	normal	14	12.7	26	37.1	40	22.2	14.75	0.001*
	abnormal	96	87.3	44	62.9	140	77.8		
TG	normal	88	80.0	59	84.3	147	81.7	0.525	0.469
	abnormal	22	20.0	11	15.7	33	18.3		

χ^2 – chi-square statistic, p – statistical significance,

Changes in the malignancy level of the tumour and the lipid profile in the group of women with breast cancer

A number of statistically significant observations can be drawn from the conducted analyses. 54% of women with low-grade tumours, 73.3% of women with moderate-grade tumours and 80% of women with high-grade tumours have abnormal TC levels. In general, this result was abnormal for all grades, but the higher the grade the higher the percentage of abnormal TC results. HDL-C was normal in 77.8% of women with low-grade tumours, which was statistically significant. 72% of women with moderate-grade tumours had normal HDL-C

values. 66.7% of patients with a highly malignant grade of tumour had abnormal HDL-C results. Significantly more women with highly-malignant carcinomas (46.7%) had abnormal TG results than women with low-grade malignancy tumours, 84.4% of whom exhibited normal results and moderate-grade malignancy tumours, 84% of whom exhibited normal results. The collective percentage of studied women in three histologic grade groups for breast cancer, depending on the abnormal result in the lipid profile is presented in table 2.

Table 2. The correlation between abnormal results in the standard lipid profile and the histologic grade of the tumour (G)

		grade						χ^2	P
		G1		G2		G3			
		n	%	n	%	n	%		
Age	up to 44	1	6.7	12	24.0	11	24.4	6.638	0.356
	from 45 to 54	3	20.0	13	26.0	12	26.7		
	from 55 to 64	4	26.7	16	32.0	10	22.2		
	65 and more	7	46.7	9	18.0	12	26.7		
TC	normal	23	46	4	26.7	9	20	7.561	0.023*
	abnormal	27	54	11	73.3	36	80		
HDL-C	normal	35	77.8	36	72	5	33.3	10.76	0.005*
	abnormal	10	22.2	14	28	10	66.7		
LDL-C	normal	1	6.7	10	20	3	6.7	4.365	0.112
	abnormal	14	93.3	40	80	42	93.3		
TG	normal	38	84.4	42	84	8	53.3	7.722	0.021*
	abnormal	7	15.6	8	16	7	46.7		

χ^2 – Pearson’s statistic, p – statistical significance,

DISCUSSION

Characteristics of study

Of the two studied groups of women, the group of women with breast cancer was more numerous than the control group. The size difference between the two groups was dictated by the place where the research was conducted.

The impact of lipid disorders on breast cancer development in women.

This analysis demonstrated that higher-than-normal, i.e. over 200 mg/dL, levels of total cholesterol (TC) were significantly more frequent in women with breast cancer than in the control group. Abnormal TC was found in 20.2% more women with breast cancer than healthy women. The study conducted by Qadir and Malik [14] showed that a moderate increase in cholesterol level in the blood serum was 21% more frequent in women with breast cancer than in healthy women. Several studies demonstrated a positive correlation between the TC value and both breast cancer incidence [20] and increased all-cause mortality in

patients with the cancer disease [21]. Other studies showed that there was no correlation [22], and that there was an inverse relationship between TC levels and cancer incidence [23].

The analysis of the HDL-C value revealed that abnormal values were more prevalent in the group of women with breast cancer than in the control group. Abnormal HDL-C values were present in 20.9% more women with breast cancer than in control group women. In the study by Martins et al. the majority of the control group also had a better, i.e. higher level of HDL than women with breast cancer [24]. In accordance with the hypothesis that high HDL-C levels might have a protective effect [13, 25] against breast cancer [12], Chang et al. demonstrated that the lower level of HDL-C might cause a significant, nearly threefold, increase in the risk of breast cancer, while other researchers did not find any connection in this area [22, 26, 27]. Even though the “good” cholesterol that is HDL-C does not play a direct role in breast cancer, Norwegian scientists [28] recognise the advisability of screening tests among women with high levels of androgens (including testosterone), as they are also connected with the development of breast cancer and cause a reduction in HDL-C levels. That is why the extremely low level of “good” cholesterol among those women might serve as an indicator of potential breast cancer development [22].

Significantly more women with breast cancer had higher-than-normal, i.e. over 100 mg/dL, LDL-C values than healthy women. LDL-C was 24.4% higher in the group of patients with cancer than in the control group. Studies by Laamiri et al. [22] and Martins et al [24] also demonstrated an increase in LDL-C concentration in patients with breast cancer in comparison to the control group. Higher levels of LDL-C, which is more prone to oxidation, in the serum might lead to high lipid peroxidation in breast cancer patients. This might cause oxidative stress leading to cell damage, which triggers their reconstruction and the proliferation of neoplastic cells [29]. LDL-C, which is significantly tied to breast cancer progression, might be helpful in the identification and observation of a high-risk medical group [30].

The analysis of the TG level, with the reference range below 150 mg/dL, did not show any statistically significant difference between women with breast cancer and healthy women. Similar results were obtained by Peela et al., [31], and in a Danish study, demonstrating a statistically insignificant negative correlation between TG and breast cancer. Several other studies demonstrated a significant increase in TG value in patients with breast cancer [22, 24, 31, 32].

Preventing the rise of cholesterol levels, both by limiting its availability and reducing its intracellular synthesis, might inhibit tumour growth and prevent carcinogenesis [33]. Dividing neoplastic cells are known to have a heightened demand for cholesterol, forming an indirect pathway for its biosynthesis. The regulation of cholesterol synthesis process is also increased. Higher transcription also causes an increased synthesis of cholesterol in neoplastic cells [34], which is seen as an increased risk factor for breast cancer [35, 36].

The impact of lipid disorders on breast cancer prognostic factors

It was revealed that tumour size and the condition of the lymph nodes were not significantly correlated with the lipid profile among the studied women with breast cancer. Furthermore, no studied patients had distant metastasis.

Cancer grading revealed the statistically significant correlation in that the more advanced the stage of carcinoma the higher the percentage of abnormal TC results. Most patients with a low and moderate grade of carcinoma had normal HDL-C results, a statistically significant correlation. Most patients with a highly malignant grade of tumour had abnormal HDL-C results. Significantly more women with highly-malignant carcinomas had abnormal TG results than women with low- and moderate-grade malignancy tumours, who exhibited

normal results. Similar study results were found, also demonstrating a relationship between increased TC, LDL-C and reduced HDL-C and the cancer grade [15]. In another study, TC, LDL-C and TC to HDL-C were significantly increased in all four stages of breast cancer, whereas the HDL-C and VLDL values did not change significantly [14]. These results are consistent with Paillasse et al., [37]. A study by Hasija and Bagga [15] demonstrated that the TG value was significantly increased, especially in stage IV patients with breast cancer [38]. It is assumed that a certain cholesterol level is essential for the proliferation of cancer cells in hypercholesterolemia, which renders these cells well-prepared for progression. This might explain the observed correlation between the LDL-C value, and the tumour size and disease progression. It was demonstrated that the LDL-C value is significantly correlated with breast cancer progression and might be useful in the identification and observation of women in groups with a high risk of breast cancer. In this light, the LDL-C value emerges as a prognostic factor for breast cancer. In addition, these results are supported by the role of TC in breast cancer progression, indicating that cholesterol metabolism might be a therapeutic goal in the treatment of this type of cancer [39].

Conclusion

Among the studied women with breast cancer, significantly more patients had abnormal TC, HDL-C and LDL-C levels than women in the control group. TC was abnormal for all grades and the more advanced the cancer stage, the higher was the percentage of abnormal results. The majority of patients with a highly malignant grade of tumour had abnormal HDL-C results. Significantly more women with highly-malignant carcinomas had abnormal TG results than women with low- and moderate-grade malignancy tumours, who exhibited normal results.

Implication for nursings

Finally, health prophylaxis cannot be ignored as a factor significantly contributing to the prevention of an abnormal lipid profile. In particular, community nurses should be involved in activities supporting preventive healthcare, especially on the primary and secondary prevention level. As representatives of a social trust profession who have contact not only with patients but also with their families and their immediate environment, nurses have a great opportunity to effectively promote healthy lifestyle and activities aimed at early cancer detection. However oncology nurses should be involved in tertiary prevention level. This should lead to cancer risk reduction and also a better prognosis when the disease is diagnosed.

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