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Spectrum of Lipid Profile among Cancer Patients: Pre and Post Treatment Analysis, a Prognostic Factor Determining Quality of Life

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Abstract

The objective of the study was to analyze the lipid profile among cancer patients and their pre and post treatment evaluation to monitor the effect of Lipids in cancer progression.It was a retrospective observational study conducted at Shaukat Khanum Memorial Cancer Hospital from January 1st 2023 to January 1st 2025. Serum samples of 392 patients were included in the study that were already analysed on automated chemistry analyser Atellica for serum lipid profile along with two levels of Quality Control by BioRad. The lipid profile included serum total cholesterol, triglyceride (TGs), low-density lipoprotein (LDL), and high-density lipoproteins (HDL). Kolmogrov's Smirnov test was applied for normality. For pre-post treatment comparison, Wilcoxon rank sum test was used. The data was analysed using SPSS version 29. The results showed that about 63% females participated compared to 37% males. Participants were put in four age groups and lipid parameters were highest in the age group of 26-40. Breast carcinoma was the most frequent (41%) followed by CA Colon (7.4%). There was a significant difference (P value< 0.005) in lipid parameters pre and post-treatment except HDL-C (P value=0.538). We also found a significant difference in serum lipids with highest and the lowest value of LDL-C in CA Breast and CA kidney (116 ± 38.9 vs 89 ± 33.1). It was concluded that for early monitoring of the disease, patients can be grouped as low and high risk depending on their LDL levels. Furthermore, LDL-C proved to be a target for treatment in cancer patients for restricting the growth and progression of the disease.

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1. Introduction

Malignancy has become one of the leading cause of deaths worldwide with a very high rate of disabilities among patients. From the past few years, the role of hyperlipidemia has become interestingly important in association with cancer prognosis [1]. Therefore, understanding the role of different lipid parameters, environmental factors, lifestyle and genetics leading to complex biological processes causing cancer development and progression is of prime importance [2,3].

Various studies have been published related to cancer incidence and hyperlipidemia [4]. Therefore, the examination of lipid profile in patients with different cancers is important, particularly due to its potential to improve treatment based on a higher prognostic significance [5,6]. For instance, low-density lipoprotein (LDL) is among the most important and determining factor in the etiology of many diseases and has recently been considered a possible risk factor for a number of cancers [7]. Thus focusing this parameter in cancer patients and reducing its level could be beneficial in reducing cancer risk in our population.

On the other side, analysis of lipid profile before and after getting cancer treatment relating to reduction in cancer progression in such patients could provide us the clear picture of the valuable role of lipids in cancer evolution and the prediction of the disease.

All cell membranes contain lipids as a structural component; it exists as either free cholesterol or bound to various lipoproteins or fatty acids. The rapid proliferation of cancer cells requires many supporting factors for their growth. Lipids are one such component necessary for a number of biological processes, such as cell division and the advancement of malignant tissues [8,9]. Targeting lipid parameters in cancer patients and guiding such patients about their living standards including dietary pattern and physical activity would be beneficial in improving the outcome of cancer therapies and will enhance patient satisfaction [10].

For this purpose, we planned a research study to assess the lipid profile and the pre and post treatment comparison of lipids among cancer patients who were sent to an oncology clinic at Shaukat Khanum, Memorial Cancer Hospital to elucidate the relationship between hyperlipidemia as the key marker of cancer progression in various cancers. Our main aim is to detect lipid abnormalities in different cancers and effect of therapy on such abnormalities. This will help to increase survival, improve quality of life in cancer patients and physician in taking decision regarding treatment approaches.

2. Materials and Methods

It was a retrospective cross-sectional study conducted at Department of Chemical Pathology, Shaukat Khanum Memorial Cancer Hospital and Research Center, Lahore. About more than 2000 incident cancer cases reported to the Shaukat Khanum Memorial oncology clinic from January 2023 to January 2025. Ethical approval was taken from Institutional Review Board (IRB). After initial assessment of the data, 392 cases were selected excluding all cases having no record of their follow up serum lipid analysis and with incomplete files.

Information was gathered about the patient's lipid profile, demographics and type of cancer. Multiple logistic regression models were used to show the relationship between lipid profile and various cancers after adjusting for age and gender. Samples were already analysed on automated chemistry analyser Atellica by Siemens for serum lipid profile. Quality of the analysis was ensured by running two levels of Quality Control by BioRad in each shift. The lipid profile analysis included parameters such as serum total cholesterol, triglyceride, low-density lipoprotein (LDL), and high-density lipoproteins (HDL). We took NCEP ATP III Guidelines for cut off values which the laboratory was already using as for serum Triglycerides TGs) as <150 mg/dL, serum Total Cholesterol (TC) as <200 mg/dL, serum LDL Cholesterol as <100 mg/dL and serum HDL Cholesterol as >40 mg/dL.

Serum sample (5ml) of cancer patients was received in Gel tube with yellow top. Then the samples were centrifuged at 3500 rpm for 3 minutes. The samples were analysed by the technique of Photometry and results were transferred to LIS.

The data was entered and analysed using SPSS version 29. Gender distribution was presented in the form of pie chart and for age distribution, bar chart was used. Data was assessed for normality using Kolmogrov's Smirnov test. As data was found to be non-normal, the median (IQR) was reported and for pre-post treatment comparison of lipid profile analysis, the Wilcoxon rank sum test was applied. P-value < 0.05 was considered significant.

3. Results

The results showed that among 392 patients, 63% females (Figure:1) participated, compared to 37% of males, and majority of females had diagnosis of breast carcinoma as shown in the Figure 2. Fig 2 also shows that among all cancers, breast carcinoma was the most frequent (41%) followed by CA Colon (7.4%) and Carcinoma of kidney (7.4%), indicating the need to focus on such cases for early diagnosis and appropriate treatment.

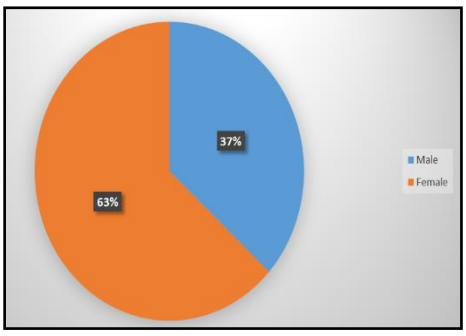

Figure 1: Gender distribution among cancer patients

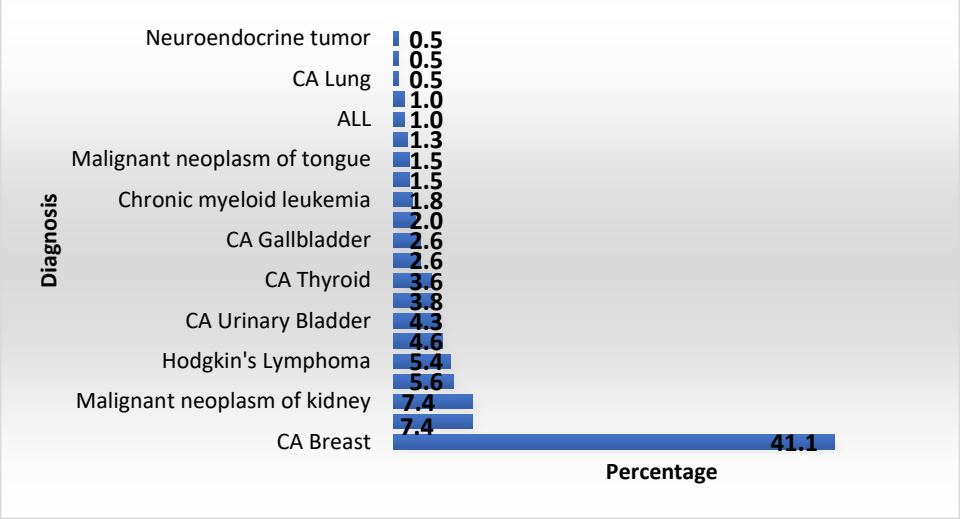

Figure 2: Distribution of different cancers among Pakistani population

For age wise distribution, we categorized the age in 4 groups as mentioned in the Table: 1. It has been shown that maximum participants (62%) were in the age group of 41-60 while serum Cholesterol, TGs and LDL-C were highest in the age group of 26-40 showing an increasing threat of cancer prevalence at an early age however, mean age of all the participants was 50 with IQR of 17. There is a significant difference ($P < 0.001$) in Serum Cholesterol and LDL-C values between different age groups.

Table 1: Age distribution of the cancer patients

Age groups(n=392)	**Serum Cholesterol**	**Serum Triglyceride**	**LDL-C**	**HDL-C**
25 and below (6)	152 ± 51.9	176 ± 45.8	104 ± 44.3	24 ± 10.7
26-40 (52)	207 ± 69.6	369 ± 506.9	122 ± 43.3	39 ± 8.8
41-60 (246)	188 ± 53.6	249 ± 284.7	115 ± 38.5	39 ± 8.8
60 and above (88)	168 ± 42.7	232 ± 305.7	97 ± 88	38 ± 9.8
***P* value**	< 0.001	0.06	< 0.001	0.2

Data presented as Mean ± SD, LDL: Low Density lipoprotein, HDL: High Density Lipoprotein

Table 2: Pre and post treatment comparison of serum lipids by cancer type

Parameters	Pre-treatment	Post-treatment	CA Breast	CA Colon	CA Kidney	CA Prostate	*P* value (<0.005)
	Median (IQR)	Median (IQR)	Mean±SD	Mean±SD	Mean±SD	Mean±SD	
Cholesterol	179.50(68)	167.5(58.0)	194 ± 55.3	191±89.9	154± 38	173 ± 53	0.001**
TG	188.5(141)	179.0(128)	281 ± 342	384 ± 86	220 ±102	203 ± 90	0.002**
LDL-C	111.5(59.0)	100.5(57)	116 ± 38.9	101 ± 8.3	89 ± 33.1	105 ± 43	0.001**
HDL-C	39.0(13.0)	39.0(12)	40 ± 8.8	39 ± 8.1	33 ± 5.6	39 ± 10.3	0.538

**** Highly statistically significant, LDL: Low Density lipoprotein, HDL: High Density Lipoprotein, TG: Triglycerides**

In Table 2, for descriptive statistics, median (IQR) is presented and for inferential statistics, Wilcoxon rank sum test is used. We observed that in Table: 2, there was a significant difference (P value < 0.005) between pre and post treatment values of Serum Cholesterol, TGs and LDL, however, the HDL values remain almost same (P value 0.538). The reduction in lipid profile parameters post-treatment except HDL also shows effect of chemotherapy on cholesterol and LDL. The level of LDL was above desirable limit (>100mg/dl) i.e. 111.5(59.0), before any therapy; however, total cholesterol remained below cut off. This can also explain the role of LDL in cancer cells survival and its progression.

We have mentioned the most frequent cancers in Table: 2. as the frequency of all other cancer was low. We also found a significant difference in serum lipids between different cancer types with the highest and the lowest value of Triglycerides in CA Colon (384 ± 86) and CA Prostate (203 ± 90) along with highest and the lowest value of LDL-C in CA Breast and CA kidney (116 ± 38.9 vs 89 ± 33.1).

4. Discussion

The role of lipids in advancement of cancer and its significance in a number of disorders is growing. With increasing awareness about the importance of lipids and its impact on the survival and quality of life, scientists are focusing more on its pathophysiology in various diseases. Lipids are important for monitoring prognosis of a disease, so it has become essential to work on such parameters to improve treatment outcome and survival period among cancer patients. A study conducted by Dong-Yeon Lee in Korea in 2022 has shown that lowering LDL-C leads to more survival rate in cancer patients [11]. Despite in cancer, the role of dyslipidemia has been observed significantly important in many other diseases like Metabolic Syndrome, Hypertension, Chronic Obstructive Pulmonary Disease (COPD), and coronary artery disease [12,13,14].

Previous data shows that alterations in lipid metabolism have been observed in various types of cancer [15]. Keeping this in mind, we decided to assess spectrum of lipid profile among cancer patients and the effect of treatment on lipid parameters in such patients. The results of the study showed that there is significant difference (P<0.001) in cholesterol, triglycerides and LDL-C, pre and post treatment but HDL-C remained almost same both before and after therapy. The improvement in LDL-C post chemotherapy indicates that decreasing the levels of cholesterol especially LDL-C could decrease cancer progression. Our study could also help by triaging patients on the basis of LDL-C for getting cancer treatment so that the patients having greater risk of cancer progression could be treated on priority basis and their survival could be increased with better quality of life.

A study conducted by Trygve Lofterod and his colleagues in Norway in 2018 and another study conducted in Poland on the role of LDL-C in cancer also supported our research by explaining that the lipid profile may function as a prognostic indicator in cancer patients forecasting their future prognosis and course of treatment [16,17]. Our research data also showed that there is an increased level of lipid parameters among our population within the age bracket of 26-40 years. Also, the most prevalent cancer found out to be breast carcinoma followed by CA Colon and CA Kidney among Pakistani population. This indicates that there must be some specific factors in such age group which could be social stress, environmental factors and diet patterns leading to cancer at an early age and could pose a major threat to the new generation [18,19]. Breast cancer being the most prevalent carcinoma in young population points towards that there is a need to detect this cancer at an early stage either by modifying the protocol for its detection or by creating more awareness about its clinical symptoms.

There is review article including 74 research studies from different countries like USA, China, Denmark, Pakistan, Poland and Norway showing that there is a positive association between LDL-C and the risk of breast cancer and the size of the tumor. The findings were suggestive of that LDL-C could act as a marker for monitoring the progression of various cancers. In fact, increased levels of lipids could have a major role in the pathophysiological appearance and evolution of different cancers [20,21]. However, as was previously said, the study's findings are debatable, necessitating further extensive research on the subject. Clarifying a method that can account for the outcomes will also be important**.**

In a study conducted by Laisupasin and his colleagues on 249 patients with early breast cancer along with 154 normal participants. The investigations concluded that patients with breast cancer had considerably greater levels of triglycerides, LDL-C, and VLDL-C than people without the disease. Nonetheless, there was no difference in total cholesterol and HDL-C between those with cancer and those without it [22].

Similarly, in an observational study carried out in Spain by Crespo-Sanjuan and his colleagues involving 128 patients with a 3 year follow up of colorectal carcinoma. The study suggested the relevance of oxLDL as an early marker of cancer risk. Whereas HDL-C was low in these patients indicating its defensive function [23]. In past, many studies have concluded that LDL-C is gradually associated with carcinogenesis. The reason may be due to an increase in LDL-C uptake and its receptor activity. Additionally, oxidative stress can also stimulate carcinogenesis leading to oxidation of low-density lipoprotein [24].

Taken together, we can say that higher levels of serum cholesterol specially LDL-C is associated with predictive risk of many cancers like breast cancer, colon cancer and prostate cancer etc. and can also lead to metastasis in advance disease.

5. Limitations

1. Further follow up of the patients and monitoring of symptoms should be done for better understanding of the LDL role in cancer.
2. Effect of oral medicines and drug interactions should be ruled out in lowering lipid levels.

6. Conclusion

Our study concluded that the lipid biomarkers especially LDL-C could assess the development of various types of cancer. For early monitoring of the disease, patients can be grouped as low and high risk depending on their LDL levels. Furthermore, targeting LDL-C in cancer patients and counselling of such patients could aid in restricting the growth and progression of the disease.

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