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Evaluating SOD1 as a Prognostic Factor in Leukemia

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ABSTRACT
Background: Oxidative stress has been implicated in the pathogenesis of leukemia, with superoxide dismutase (SOD) playing a critical role in the defense against reactive oxygen species (ROS). The assessment of SOD levels in leukemia patients can provide insights into the oxidative stress profile and its association with the disease. Methods: This cross-sectional study involved 10 patients diagnosed with leukemia and 10 healthy controls. SOD levels were quantified using an enzyme-linked immunosorbent assay (ELISA), a highly sensitive method allowing for precise measurement of the enzyme activity in the blood. Results: The patient group exhibited higher mean (19,759) and median (15,079) SOD levels compared to the control group (mean: 13,445, median: 11,562). However, a substantial overlap in SOD levels was observed between the two groups, as evidenced by the standard errors (patient group SE: 4794, control group SE: 2373). The difference in SOD levels did not achieve statistical significance (P-Value: 0.253), suggesting that within the limits of the study's scale and design, the results did not conclusively indicate a distinct difference in SOD levels between patients with leukemia and healthy individuals. Conclusion: Although an increased trend in SOD levels was noted among leukemia patients, the study did not find a statistically significant difference. The results warrant further investigation with a larger cohort to determine the relevance of SOD levels in leukemia and its potential as a biomarker for oxidative stress-related pathology in the disease.

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1-INTRODUCTION

Superoxide dismutase 1 (SOD1) is an intracellular enzyme that serves as a crucial antioxidant defense by converting superoxide radicals into hydrogen peroxide and oxygen. The significance of SOD1 within the context of leukemia stems from its potential role in influencing the disease's progression and response to treatment. Leukemia, a heterogeneous group of hematological malignancies characterized by the clonal proliferation of white cells, is known to involve oxidative stress in its pathobiology. Research has highlighted that leukemia cells often exhibit dysregulated redox states with altered ROS dynamics, which are critical for cell signaling and survival [1]. SOD1, by modulating ROS, may influence leukemic cell proliferation, differentiation, and apoptosis. Consequently, the activity of SOD1 and its expression

levels have been scrutinized as potential prognostic factors in leukemia. There is evidence to suggest that the enzymatic activity of SOD1 may correlate with the aggressiveness of certain leukemia subtypes. For instance, studies have observed that higher SOD1 activity might be associated with a poor prognosis in acute myeloid leukemia (AML) due to its role in protecting leukemic cells from ROS-induced damage, thereby conferring resistance to apoptosis [2].

Moreover, the response of leukemia to chemotherapy can be impacted by SOD1 activity. Anticancer agents often induce ROS generation as a mechanism of action, and elevated SOD1 activity could mitigate this effect, leading to drug resistance. As such, SOD1 inhibitors or modulators are being investigated as adjuvant therapeutic strategies to sensitize leukemic cells to standard treatments [3].Furthermore, SOD1's genetic variations, such as single nucleotide polymorphisms, are being explored for their potential to serve as biomarkers for susceptibility and prognosis in leukemia. For instance, certain SOD1 polymorphisms have been implicated in modifying the risk of developing chronic lymphocytic leukemia (CLL) [4].

METHODS

The blood samples were collected from Al-Kadhimiya Teaching Hospital and Ibn Al-Balady Hospital in Baghdad(December 2023- April 2024). Serum blood was collected for serological analysis. The groups were divided into main groups: control and patients. The control involved 10 healthy patients. The patient group involved 10 samples also. By using the ELISA method (Biotech, USA), blood samples were examined for SOD enzyme.

Ethical consent

The consent for blood collection was obtained from the leukemic participants and by anethics committee in Iraqi Ministry of Health .

RESULTS

After the completion of measuring SOD activity the results of each sample are showing in table (1). The samples have been grouped to patients and control groups.This study investigated the superoxide dismutase (SOD) levels in patients diagnosed with leukemia compared to a control group. Both groups consisted of 10 individuals each. The mean SOD level in the patient group was found to be 19,759, with a median of 15,079 and a standard error (SE) of 4,794. In contrast, the control group presented a mean SOD level of 13,445, a median of 11,562, and a standard error of 2,373. While there is an observed difference in the mean and median SOD levels between patients and controls, the statistical significance of this difference, as indicated by the P-Value of 0.253, does not support a statistically significant difference at the conventional alpha level of 0.05. This suggests that, despite the higher mean and median levels of SOD observed in the patient group, the variability within the sample data does not provide sufficient evidence to conclude that there is a significant difference in SOD levels between patients with leukemia and the control group within the sample size studied.

Table (1); SOD activity results of each samples included in this study

Group	Sample Number	SOD concentration (µmol/l)
patients	1	18733.78
	2	26149.31
	3	10947.37
	4	7278.422
	5	11423.87
	6	21829.11
	7	10723.56
	8	6799.457
	9	26149.31
	10	57555.055
Control	11	18092.21
	12	26149.31
	13	5867.446
	14	24916.38
	15	11943.23
	16	11180.6
	17	6890.261
	18	8605.235
	19	15006.34
	20	5800.884

Table (2); Comparative Analysis of SOD Mean between Patients with leukemia and Controls

Group	N	Mean	Median	SE	P-Value
Patient	10	19759	15079	4794	0.253
Control	10	13445	11562	2373	

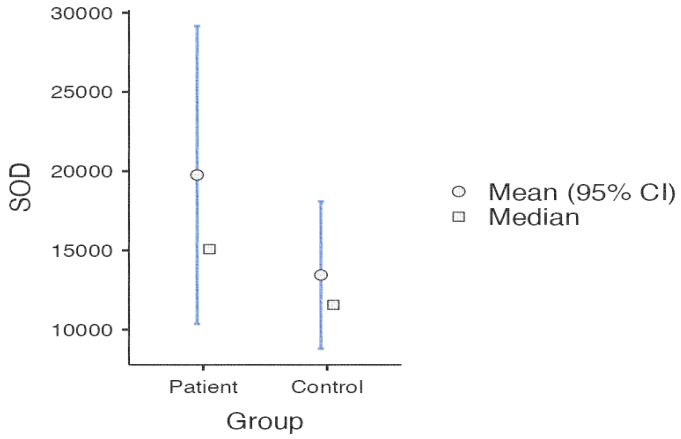

Figure (1); Comparative Analysis of SOD Mean between Patients and Controls

DISCUSSION

The investigation into the SOD levels in patients with leukemia compared to a healthy control group has yielded intriguing insights, although the differences observed were not statistically significant. The higher mean and median SOD levels in the patient group could suggest a biological response to oxidative stress caused by the leukemia pathology. Indeed, previous studies have postulated that SOD activity may increase as a compensatory mechanism in response to elevated reactive oxygen species (ROS) levels associated with various malignancies, including leukemia (5,6).

The absence of statistical significance (p=0.253) in this study could be attributed to several factors. Firstly, the sample size of 10 individuals per group may have been insufficient to detect a small to moderate effect size. Studies with a larger sample size might be warranted to verify these findings. Additionally, the high standard error in the patient group indicates considerable variability, which could mask any true difference in SOD levels between the groups. Variability in SOD levels could result from the heterogeneity of the

leukemia diagnosis itself, encompassing various subtypes with potentially differing impacts on oxidative stress and SOD production.

Another consideration is the control group's SOD levels, which, while lower on average, also exhibit a range of values denoted by their standard error. The selection criteria for control individuals, their environmental exposures, and lifestyle factors not accounted for could influence SOD levels, thus impacting the comparative results.

It is also critical to align these results with the current understanding of SOD's role in oncogenic processes. For instance, (7) found that SOD levels could be altered not only by the presence of malignancy but also by treatments such as chemotherapy and radiation. Therefore, any prior treatments received by the patient cohort could have influenced their SOD levels, suggesting the need for stratification and analysis of treatment-naive and post-treatment patients in future research.

CONCLUSIONS

This study explored the superoxide dismutase (SOD) levels in a cohort of patients with leukemia compared to a control group, aiming to identify potential differences that might contribute to our understanding of the disease's pathophysiology. The results indicated higher mean and median levels of SOD in the patient group compared to the controls, yet the difference did not reach statistical significance (p=0.253).

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