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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]. Through the regulation of ROS, SOD1 can possibly play a role in regulating proliferation, differentiation, and apoptotic

activities of leukemic cells. Thus, the SOD1 activity and expression will be affected.

The levels have been assessed as the possible prognosis indicators of leukemia. It has been indicated, based on some tendencies, the enzymatic activity of SOD1 can be associated with the aggressiveness of some leukemia types. Indicatively, when the condition of acute myeloid leukemia (AML) is concerned, it has been documented that the increased SOD1 activity may indicate worse prognosis as leukemic cells are resistant to ROS-mediated cell damage through this activity [2].

More so, SOD1 activity can affect response of leukemia to chemotherapy. The frequent mode of anticancer action is the generation of ROS and enhanced SOD1 activity may counteract this occurrence, causing drug resistance. Consequently, SOD1 inhibitors/modulators are under investigation to develop as adjuvant therapeutic interventions that can sensitize leukemic cells against conventional therapeutics [3].In addition, genetic variation of SOD1, e.g., single nucleotide polymorphisms, is also being characterized as a possible source of susceptibility and prognostic indicators in leukemia. As an example, some SOD1 polymorphisms have been associated with alteration of the likelihood of chronic lymphocytic leukemia (CLL) development [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	

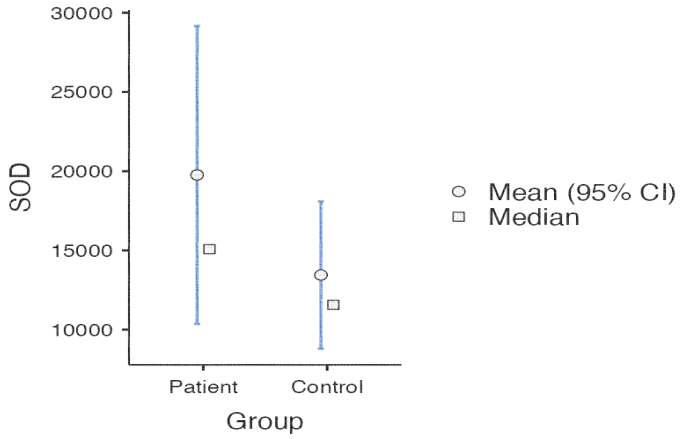

Figure (1); Comparative Analysis of SOD Mean between Patients and Controls

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 the

diagnosis of leukemia itself since different forms might have different effects both on oxidative stress and SOD production.

The other factor is the sample of the control group on the SOD level that is lower on average but also carried with the range of values being expressed with the indicator of the standard error. The selection aspects of the control individuals, their environmental exposure, and other other non-modifiable aspects of the life may have role to play when it comes to the level of SOD and therefore affect the relative results.

There is also the need to compare these findings with that of what is known currently about the SOD work in oncogenic process. As an example, (7) established that levels of SOD may be changed not just by the existence of malignancy but also by chemotherapy and radiative treatment. The treatment needs of the patient cohort, therefore, may have also affected their SOD levels indicating that there will be the necessity of stratification and analysis of treatment naive and post-treatment patients in further studies.

CONCLUSIONS

This research project was about the investigation on the levels of superoxide dismutase (SOD) in a group of patients with leukemia as compared to a control group with the aim of pinpointing possible variations that could form the basis of our knowledge on the pathophysiology of the disease. The findings showed the mean and median values of SOD in the patient group were higher than that of the control, but the disparity was still not important (p=0.253).

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