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Assessing SOD 1 Activity in Thalassemia: New insights

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ABSTRACT
Thalassemia is an inherited blood illness where there is a decrease or lack of one or more globin chains in haemoglobin, resulting in anaemia and associated problems. The disease's pathogenesis includes inadequate erythropoiesis, hemolysis, and significant oxidative stress caused by iron excess, particularly in patients receiving frequent blood transfusions. The ELISA technique was utilised to quantify the amounts of superoxide dismutase1(SOD1) in the samples under investigation. Each group comprised 10 participants. The average SOD level in the patient group was 17,856 units, with a median of 16,492 units and a standard deviation of 6,391 units. The control group had a mean SOD level of 19,915 units and a median of 13,548 units, showing a higher variability with a standard deviation of 16,874 units.

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1-INTRODUCTION

Thalassemia is a group of inherited blood disorders characterized by the reduction or absence of one or more of the globin chains in hemoglobin, leading to anemia and various other complications [1]. The disease's pathophysiology involves not only ineffective erythropoiesis and hemolysis but also a marked state of oxidative stress due to iron overload, especially in patients who undergo regular blood transfusions [2]

Superoxide dismutase 1 (SOD1), a critical antioxidant enzyme, catalyzes the dismutation of the superoxide anion into hydrogen peroxide and molecular oxygen, mitigating the harmful effects of superoxide radicals produced during normal cellular metabolism [3]. The constant oxidative stress in thalassemia may overpower the antioxidant defense systems, such as the activity of the SOD1, and result in the destruction of the cells and the disease pathology [4]. Investigation has proposed that expression of SOD1 activity in thalassaemic patients may form novel understanding of the oxidative stress disease model and the predictable effect of antioxidants [5]. Besides, it has been reported that manipulation of SOD1 activity could also be used in the moderation of iron overload and oxidative damage associated with it [6].

The current study is undertaken to determine the activity of SOD1 in thalassemic patients and the comparison of its activity in health controls in order to evaluate the mechanism of oxidative stress in thalassemia. Within the scope of studying the SOD1 activity profile, it is expected that some possible biomarkers of oxidative stress will be found and that new therapeutical approaches to alleviating the consequences of thalassemia can be investigated.

2-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 SOD1 enzyme.

Ethical consent

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

3-RESULTS

After the completion of measuring SOD activity the results of each sample are showing in table (1). The samples have been grouped to patient and control groups.

Table (2) presents the comparative analysis of the mean superoxide dismutase (SOD) levels between the patient group and the control group. Both groups consisted of 10 individuals each. The mean SOD level in the patient group was 17,856 units, with a median of 16,492 units and a standard deviation (SD) of 6,391 units. In contrast, the control group exhibited a higher mean SOD level of 19,915 units and a lower median of 13,548 units, with a significantly larger variability as indicated by the SD of 16,874 units. Despite the observed differences in mean and median SOD levels between patients and controls, the statistical analysis indicated a p-value of 0.722. This p-value is greater than the conventional alpha level of 0.05, suggesting that there is no statistically significant difference in the mean SOD levels between the two groups. The large standard deviation in the control group points to a high degree of variability in SOD levels among the control subjects, which may have influenced the statistical outcome.It is important to note that the higher mean value in the control group coupled with the lower median suggests a skewed distribution, potentially indicating the presence of outliers or a non-normal distribution of SOD levels in this group. However, the lack of statistical significance implies that the difference in central tendency measures (mean and median) between patients and controls does not reflect a systematic difference in SOD levels attributable to the condition being studied.

-DISCUSSION

The objective of this study was to assess the activity levels of superoxide dismutase (SOD) in patients diagnosed with thalassemia compared to a healthy control group. The data presented in Table (2) showed mean SOD activities of 17,856 units for thalassemia patients and 19,915 units for controls, with a p-value of 0.722, indicating no statistically significant difference between the two groups. Thalassemia is associated with increased oxidative stress due to the chronic hemolysis and iron overload that typify the disease [7]. The enzyme SOD plays a critical

role in mitigating oxidative damage by converting superoxide radicals into less reactive species. Given the oxidative stress in thalassemia, one might expect to observe altered SOD activity in this patient population.

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

Group	Sample number	SOD concentration (µmol/l)
patients	1	14831.76
	2	29229.06
	3	10131.7
	4	9767.029
	5	26370.55
	6	14437.9
	7	20404.17
	8	17736.36
	9	15247.75
	10	20404.17
Control	11	1753.451
	12	8814.22
	13	21202.37
	14	15687.81
	15	23003.74
	16	47280.92
	17	8673.05
	18	51896.77
	19	9427.528
	20	11408.43

Table (4-2); Comparative Analysis of SOD Mean between Patients and Controls

Group	N	Mean	Median	SD	P-Value
patient	10	17856	16492	6391	0.722
control	10	19915	13548	16874	

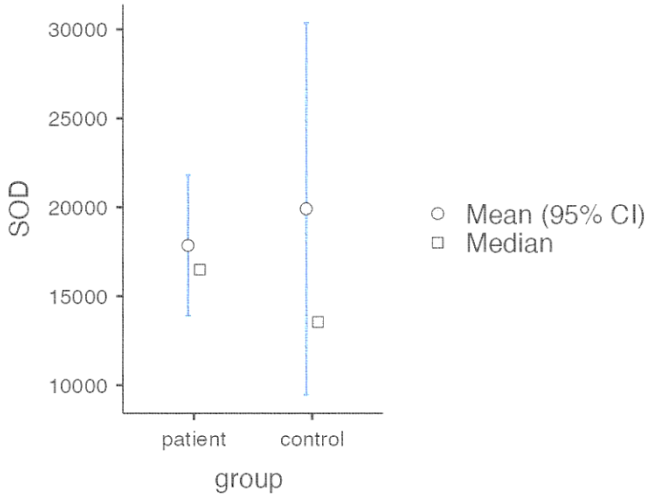

Figure (1); Comparative Analysis of SOD1 Mean between Patients and Controls

The absence of a significant difference in SOD activity between thalassemia patients and controls in our study could suggest several possibilities. Firstly, the adaptive response of SOD to increased oxidative stress might be adequate to maintain its activity at levels comparable to healthy individuals. This compensatory mechanism might reflect an effective upregulation of SOD in response to the oxidative environment in thalassemia patients [8]. Alternatively, the lack of a significant difference could indicate that other factors contribute to the oxidative stress in thalassemia beyond the SOD-dependent pathways. The Fenton reaction of increasing iron load due to repetitive blood transfusion (commonly used as treatment of thalassemia) could create high concentration of highly reactive OH radicals which would not be suppressed by SOD activity [9]. The second thing to consider is the high degree of inconsistency in SOD of the control

group, which supports this observation with a significant standard deviation. Such heterogeneity may be due to the compliance of the control population or broad normality of SOD activity. In addition, the large standard deviation of those in the control group indicates that it would need to take a larger sample in order to obtain the statistical power needed to identify possible variations [10].

Another thing worth noting is that there is the divergence between the means and the median values between patients and controls, which leads to the probability of the asymmetries in the data distribution. Such skew might be due to outliers or the samples lacking normal distribution [11].

Since SOD plays a very important part in neutralizing the oxidative stress and considering the complexity of the thalassemia pathophysiology, additional studies are necessary. The correlation between the activity of SOD and thalassemia may be explained by more detailed studies of appropriate size. Further, longitudinal analysis on activity of SOD in various phases of thalassemia and various treatment options will elicit further information regarding dynamic nature of oxidative stress in such patients [12].

CONCLUSION

To sum up, our research study did not reveal any significant change in the activity of SOD in the patients with Thalassemia compared to controls and this does not in any way refute the role of oxidative stress in the pathogenesis of Thalassemia. These findings represent the necessity of the further study of oxidative mechanisms and their clinical reflections in thalassemia.

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