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Article

Detection of immune response cells, blood indicators, and enzymatic antioxidants in individuals with cutaneous leishmaniasis

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ABSTRACT

One of the most significant zoonotic pathogens in humans, leishmaniasis, can result in serious, potentially fatal infections. This study aimed to assess the degree of the immune response in children with cutaneous leishmaniasis. The analysis of some blood parameters in the affected children revealed significant differences ($P<0.05$) in the hemoglobin rate, which was lower in the patient populations compared with the control group. The findings revealed a statistical difference in the values of the heterogeneous tiers of INF-Y, IL6, IL10, SOD, GPX, and CAT between the sick and healthy children (P 0.05). However, this rise will not only cause the parasite to die but also cause oxidative damage to the affected child's cells and tissues and may reach a level that is impossible to control, indicating the incidence of oxidative DNA damage and the beginning of an infection.

Keywords: Cytokines, enzymatic antioxidants, cutaneous leishmaniasis

INTRODUCTION

Oriental Sore is the name for cutaneous leishmaniasis. It is a dangerous illness that poses a risk to the general public's health and exhibits a variety of clinical signs. It is one of the six parasite infections affecting humans most frequently, spreading to more than 88 nations worldwide1 and dominating four continents[2]. This illness develops after contracting a parasite protozoan called Leishmania spp. A parasitic disease with animal origins is leishmaniasis. The female sand fly, a tiny insect that feeds on the blood of humans and animals and flies silently at low altitudes from the earth's surface, is what bites humans and transmits the disease[3]. The most significant species accountable for cutaneous leishmaniasis are L. major and L. tropica[4]. The relevance of the cellular immune response in the body's reaction to cutaneous leishmaniasis supports the need for testing the cellular immunity of the anti-cutaneous leishmaniasis vaccines. Since recovery from the disease is linked to long-term cellular immunity, there has been a discernible change in the immunological responses mediated by cells[5,6]. Since the particular antibodies generated for the antibodies play a minor role in regulating

the course of the cutaneous leishmaniasis mechanism, the humoral immune response to cutaneous leishmaniasis is weak[7].

Lymphokines, soluble substances produced by immune cells termed T-helper (CD4s), are crucial for the immunological response. In contrast, Th1 secretes both Interferon-gamma (INF-y) and Interleukin-2 (IL2), whereas Th2 is in charge of secreting IL4), (IL5), (IL6), (IL10), and IL13. An experimental study using infected mice found a correlation between Th1 cells and resistance to leishmaniasis on the one hand and Th2 cells and sensitivity to the disease on the other [8]. By activating mast cells and cytokines that increase inflammatory mediators, L.tropice and L. major cause inflammation. Uninfected cells suffer oxidative damage as a result, which causes the release of free radicals, including ROS and NOS, that play a significant part in tissue damage[9]. The results of the study[10] on people revealed a connection between cutaneous leishmaniasis infection and the antioxidant enzymes Superoxide Dismutase (SOD), Glutathione peroxidase (GPx), Catalase enzyme, Glutathion Reducase], and enzymatic reducing agents [uric acid UA, melatonin MEL IL, bilirubin B vitamins Dietary (A, E, B, C), iron-binding proteins.

MATERIALS AND METHODS

Sample collection

In collaboration with the Diwaniyah Health Department, the study includes a group of children with cutaneous leishmaniasis and a total of (56) patients ranging in age from 5 months to 8 years. Blood from the veins, ulcer blood samples, and tissue from the ulcer's peak were all taken. Additionally, blood serum was taken from sixteen (16) uninfected healthy participants (control group). Until the time of the test, all serums were stored at a temperature of -20 C.

Laboratory diagnosis

According to [11], the unflattered stages of the parasite were found in the fixed macrophages in the epidermal tissue, enabling the diagnosis and confirmation of the infection.

A blood test

Using the Swedish company's Autoanalyzer hematology (Swb-lab) product and 300 microliters of the sample, the total and differential numbers of white and red blood cells were determined.

Immunological study:

Using an ELISA kit from Elabscience for each assay, the quantities of INF-, IL-6, and IL-10 in the serum of affected children had been determined. I made sure to follow all kit instructions. Using a unique assay kit created by Elabscience Company for each of the enzyme antioxidants GPx and SOD, concentrations were calculated following the directions on the kit. The approach utilized by [12], which is dependent on the reduction of hydrogen peroxide (H2O2) in the presence of an enzymatic source according to the reaction: was used to measure the enzymatic activity of catalase.

$$2H_2O_2 \xrightarrow{\text{catalase}} H_2O + O_2$$

Statistical analysis:

The statistical program (SPSS) version 24 was used as the foundation for the T-test. In order to determine whether there were any significant differences between the various groups, the numerical data were reported as mean standard error and utilizing (LSD) with a probability level of ($p<0.01$), ($p<0.05$).

RESULTS

With a value of (4.21 0.031) compared to the healthy group (4.63 0.043), the data provided in Table (1) suggested a decrease in the rate of RBC. However, there was no statistically significant difference. The study found an increase in the average number of platelets (290.11 29.77 cells/ mm3) compared to healthy children (225.1 22.11 cells/mm3) and significant differences (P0.05) in the average hemoglobin level. The patient's hemoglobin level was (11.2 0.45 g/dL) compared to healthy (12.9 0.45 g/dL). Without any notable variations. With a substantial level (1P0.0) and a value of (871.3 819.5 cells/mm3), the results demonstrated a considerable rise in the overall number of white blood cells. Compared to the control group, the affected children had (549.9 611.1 cells/mm3). In addition, the results demonstrated a substantial increase (P0.01) in the average of neutrophils in the infected group, which was (4577.01 415 cells/mm3) as opposed to the control group, which was (2771.1 309.6 cells/mm3). Compared to healthy children (359 96.1 cells/mm3), the average of monocytes in the infected children (724.6 119.09 cells/mm3). The affected children's lymphocyte rate (341.2 2816.3 cells/mm3) was significantly higher. Compared to the impacted children (1715.07 139 cells/mm3). At a degree of probability (P<0.01).

Parameters	Study groups	Average	Standard er-ror	P-value
RBC	The patients	4.21	0.031	P<0.05
	control group	4.63	0.043	
Hb	The patients	11.2	0.45	P<0.05
	control group	12.9	0.45	
Platelets	The patients	290.11	29.77	P<0.05
	control group	225.1	22.11	
WBC	The patients	871.3	819.5	P<0.01
	control group	549.9	611.1	
Neutrophils	The patients	4577.01	415	P<0.01
	control group	2771.1	309.6	
Monocytes	The patients	724.6	119.09	P<0.01
	control group	359	96.1	
Lymphocytes	The patients	341.2	2816.3	P<0.01
	control group	1715.07	139	

Table 1. The effect of cutaneous leishmaniasis infection for children on the average blood parameters compared to the control group.

Compared to the Sera group (4.51 1.5 mg/dl), children with cutaneous leishmaniasis had significantly higher INF-Y rates (P0.05), rising to 99.8 4.9 mg/dl. This shows a strong correlation. There are significant conditions with statistical significance between the above values, as shown in Table (2), as the results showed an increase in the level of IL6 IL10 in the serum of infected children at a rate of (0.091 0.075 pg/ml) and (7.8 180.8 mg/dl), respectively, as compared to the control group (0.036 0.018) and 5.9 131.4 pg/ml

Cytokines type	INF-Y±Standrd erorr mg/dl	IL6± Standrd erorr mg/dl	IL10± standard error mg/del
Patients(n=56)	*99.8±4.9	*0.091±0.075	*7.8±180.8
Control group (n=16)	4.51±1.5	0.036±0.018	5.9±131.4
P-value	≤0.05	≤ 0.05	≤ 0.05

Table 2. Variations in the values of the concentrations of cytokines INF-Y, IL6, and IL10 in serum for 56 children with cutaneous leishmaniasis. A sign* indicates that there are significant differences in statistical significance.

The findings revealed that children with cutaneous leishmaniasis have varying levels of the enzyme antioxidants under investigation. According to Table 3's findings, SOD antioxidant levels significantly increased (P 0.05) in the affected children compared to the control group's value (0.018±0.017). Additionally, there was a substantial drop in the antioxidant GPX (440.05±122.9) as compared to the control group (813.98±82.2) (P 0.05). Anti-CAT levels in the affected children were significantly lower (P 0.05) than in the group of unaffected children (0.122± 0.45), as well.

Enzyme antioxidant	SOD pg/ml	GPX pg/ml	Catalase pg/ml
Patient group n=56	0.078±0.131 *	440.05±122.9	0.088±0.042
Control group n=16	0.018±0.017	*813.98±82.2	* 0.122±0.45
P–value	≤0.05	≤0.05	≤0.05

Table (3) Changes values of the enzyme antioxidants (SOD, GPX, CAT in the serum of 56 children) with cutaneous leishmaniasis compared to the control group. A sign* indicates that there are significant differences in statistical significance

DISCUSSION

In accordance with the findings, patients with cutaneous leishmaniasis had lower hemoglobin levels than those in the control group; this agrees with [13]. This might result from the parasites consuming vitamins like (C, B6, and B12), and folic acid during their growth, which lowers its content in the body and adversely impacts the production of RBC. As opposed to the control group, the patients' RBC decreased in the current data, which is consistent with [14], and the cause may be related to the potential that these cells have a short lifespan in addition to the RBC being more fragile as the infection progresses. The body's defenses against numerous infections, particularly immunization against parasites, depend heavily on platelets. The current study showed a minor rise in the rate of platelets in the patients, which is in line with previous research[15] that found infections trigger platelet activation and an increase in platelet quantity in addition to their function in inflammation and tissue healing. According to the findings, the affected children's average white blood cell count significantly increased compared to the control group. The body produces more cells, notably macrophage, which is a typical essential requisite in intracellular parasitic infections, as a result of the

stimulation of the cellular immune defense system caused by the introduction of parasite antigens, additionally to lymphocytes, whose significance is tied to the particular immunological response. The parasite's antigenic determinants, which could also stimulate the immune system of all spectrums, may cause a substantial increase in white blood cells. According to the study, the affected children's neutrophil counts were significantly higher than those in the control group. This might be because these cells will be the first non-specific defense components to get to the site of the lesion outside the bloodstream and perform their role of consuming and eliminating the pathogen[16]. Our research supported the findings [13] that leishmaniasis infection increases lymphocyte counts in individuals with cutaneous leishmaniasis. These cells are primarily responsible for creating a specific response and establishing memory during intracellular parasite infections[17]. Compared to the control group, the results demonstrated elevated INf-y, IL6, and IL10 levels in the serum of children who had contracted L. major. We concur with that 18. Their study on 2 groups of kids with cutaneous leishmaniasis, aged 10 to 5 years, in Shiraz, Iran, discovered that the disease causes significant preserved alterations for IL6 and IL10 in the blood. They explained this as the result of a decline in Colony-stimulating Factor production (GM-CSF). IL6 and INf-y levels in adult cutaneous leishmaniasis patients were considerably increased. These high concentrations are required to balance the Th1 and Th2 responses. IL10, IL4, and INf-y levels in the serum of children infected with L. major in India increased on average, according to [20]. The study of Foxp3 gene expression with IL10, INf-, and INf-y using R.T.PCR in adults with L. major affirmed higher (IL10, INf-y, INf-) values compared with the control group with statistically significant results[21]. Meanwhile, [22] indicated high concentrations of IL12, IL2, INf- and decreased IL10 and IL4 as a cellular response to the Leishmania parasite, and [23] observed no.

The resistant strains of mice are to blame for the minor concentration discrepancy. Additionally, [24] recorded an increase in the concentration of INf-y, INf- in the support group, a reduction in the disease, on either hand, an increase in IL10 concentration levels in the patient populations and a decrease in the recovery group, which suggests that the concentrations of immune cells closely correlate with the response to treatment. The cutaneous leishmaniasis parasitism mechanism works by activating the secretion of IL10, which, on the one hand, activates and raises the levels of INf-y, which stimulates phagocytes, and, on the other hand, the parasite genus within cells, which activates the positive and inflammatory response[25]. Children with cutaneous leishmaniasis L. major had higher levels of SOD and significantly lower levels of CaT and Gpx, according to research on polymorphisms in the antioxidant enzymes.

Reactive oxygen species (ROS) and reactive nitrogen species (Nos, SOD, GSH-PX) are produced in enormous quantities by macrophages, respectively. In study 28, to measure MAD as an indicator of confirmative damage in cutaneous leishmaniasis patient populations, they recorded an increase in the levels of MAD and SOD in the affected patients' red blood cells and a decrease in CAT and GSH-PX compared to the healthy control group. The results of the current study on the enzyme antioxidants were consistent with their findings. His values, however, fell short of significance. An increase in the levels of ROS and RNS in the blood and a slight decrease in the level of CAT were observed in a study of [27] patients with cutaneous leishmaniasis for age groups (1-60) years in Taiz, Yemen. This study found that the age and gender of the affected patients significantly impacted the level of catalase in the patient's serum by triggering ROS signaling systems to distinguish the parasite's polymorphisms and enhance virulence against leishmaniasis. A decrease in its concentration from the standard limits was noted in an experimental study conducted by researchers in Tehran[28]

that included the infection of mice of cutaneous leishmaniasis L. major and the impact of infection on CAT criteria. The result was interpreted due to L. major's ability to activate Th2 cells. Hence the release of cytokines. In turn, cytokines create a significant amount of reactive oxygen species (ROS), destroying macrophage parasites and harming their proteins, DNA, and lipids[29]. Our findings contrast those of [3o], who found that patients with cutaneous leishmaniasis had higher levels of CAT, glutathione peroxidase, d-glucose-6-phosphate, and dehydrogenase than the control group. Due to decreased antioxidant enzymatic activity, the body's increased generation of ROS and RNS in cutaneous leishmaniasis patients causes oxidative stress and accelerates lipid oxidation[31].

A rise in enzymatic antioxidant activity may potentially uncontrollably seed oxidative damage to tissues and cells in addition to eliminating parasites. Increased SOD activity in the spleen without a change in CAT activity may cause H2O2 to build up in the tissue, creating oxidative stress, indicating that apoptosis is beginning[32]. Therefore, to prevent harm to the oxidative DNA of individuals with cutaneous leishmaniasis, therapeutic techniques call for monitoring the amount of antioxidants and administering medication to the patient.

CONCLUSIONS

Cutaneous leishmaniasis causes excessive increases in the inflammatory cytokines (INF-Y, IL6, and IL10) and statistically significant changes in the levels of the antioxidant enzymes. The overproduction of these types (SOD, GPX, and CAT) that results in unmanageable oxidative damage to host cells must be avoided.

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