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Maroof Sabti Juma AL-Ammash

Department of Pathological
Analysis, Faculty of Applied
Science, University of
Samarra, Samarra, Iraq

Umer Abdullah Ahmed Alelyan

Department of Pathological
Analysis, Faculty of Applied
Science, University of
Samarra, Samarra, Iraq

The relationship between infection with *Enterobius vermicularis* and some Immunological and Physiological parameters

Maroof Sabti Juma AL-Ammash and Umer Abdullah Ahmed Alelyan

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Abstract

A many of digestive tract problems in humans, including diarrhea, vomiting, appendicitis, and intestinal ulcers, are caused by parasitic protozoa and helminthes. A total number 75 blood samples were taken from individuals who had *E. vermicularis* infections.

The present study reported increase in some immuological and physiological parameters under study when compared with healthy specimen.

The current investigation indicates elevated levels of IgE, IFN- γ , IL-4, IL-5, IL-10, and IL-17. in patient group contrasted healthy group, its attains (95.31 and 10.74) pg/ml consecutively, for IgE, and (122.72 and 44.57) pg/ml consecutively, for IFN- γ , while it attains (112.32 and 29.22) pg/ml consecutively, for IL-4, and also attains (101.12 and 17.49) pg/ml consecutively, for IL-5, as for IL-10, it attains (89.11 and 35.25) pg/ml consecutively, and it attains (120.30 and 28.62) pg/ml consecutively, for IL-17.

The current findings indicate a notable enhance in the concentrations of GOT, GPT, and ALP in the patient group with *E. vermicularis* contrasted the healthy group, reaching (18.57 and 2.61) ng/ml for GOT, (0.177 and 0.064) ng/ml for GPT, and (34.15 and 8.23) ng/ml for ALP, respectively.

Keywords: *Enterobius vermicularis*, immunological & physiological parameters

1. Introduction

E. vermicularis is called Pinworm that one of the most widely distributed parasitic worms among other parasitic worms (Fan *et al.*, 2019) [9]. According to Laoraksawong *et al.* (2020) [18], the number of people infected with pinworms, especially children, worldwide reaches 200 million annually. The spread of *E. vermicularis* infection is linked to unsanitary environmental conditions, lack of personal hygiene, and consumption of contaminated food (Alemu *et al.*, 2019) [1]. The infection occurs through ingestion of eggs, which can be transmitted through direct contact between infected and uninfected children (Tigabu *et al.*, 2019) [29]. Infection can also be transmitted by touching contaminated objects such as bed sheets, clothing, and bathroom supplies, or by consuming food or drink contaminated with eggs, or even by inhaling eggs in dust (Khayyat *et al.*, 2021) [16].

Pinworms can cause serious illness and injury among humans. Symptoms experienced by infected children include insomnia, nausea, vomiting, abdominal pain, diarrhea, and anemia (Dudlova *et al.*, 2018). They may also experience urinary incontinence, peeling skin around the anus, nail biting, irritability, hyperactivity, and weight loss (Hammood *et al.*, 2019) [14].

The aim of the current study was to monitor changes in some immune criteria such as IgE, gamma interferon (IFN- γ) and some interleukins, and to monitor changes in liver enzymes as a result of pinworm infection.

2. Materials and Methods

The current study was conducted from the beginning of September 2024 to December 2024. It monitored changes in the immune response in 75 individuals infected with pinworm. The immune response was studied based on changes in certain interleukins (IL-4, IL-5, IL-10 and IL-17), IgE, and gamma interferon, in addition to monitoring changes in liver enzymes compared with healthy individuals.

Corresponding Author:
Maroof Sabti Juma AL-Ammash

Department of Pathological
Analysis, Faculty of Applied
Science, University of
Samarra, Samarra, Iraq

Microscopic investigations

Direct wet mount method of stool samples is used to detect the presence of pinworm infection (WHO 1991) [31].

Gamma Interferon and Immunoglobulin E (IgE) assessments

The levels of IFN- γ and IgE in the serum were quantified utilizing a specialized assay kit produced by SUNLONG Chinese Company.

Cytokines assessment

The levels of interleukins (IL-4, IL-5, IL-10, and IL-17) in the serum were quantified with a specific assay kit produced by the Chinese company SUNLONG Company.

Measurement Liver enzymes

The levels of GOT, GPT, and ALP were measured with a commercial kit and equipment supplied by USA Antibodies Company.

Statistical analysis

Data were analyzed using the Duncan Multiple Range test, with means evaluated at a significance threshold of $p < 0.05$, employing SPSS V.22. (Cleophas and Zwinderman, 2016) [5].

3. Results and Discussion

1. Microscopic examinations

The microscopic studies comprised a wet mount smear of the patient's fecal material, utilizing Logal's iodine stain to reveal infection with *E. vermicularis*, as illustrated in Figure 1.



Fig 1: The egg of *E. vermicularis*, 400x

2. Immunity parameters

Table 1: The concentrations of Immunity parameters of each group under study

Groups and Parameters	Patient Group	Healthy Group
	Mean \pm SD (pg/ml)	
IgE	95.31 \pm 13.40 A	10.74 \pm 3.17 B
IFN- γ	122.72 \pm 24.15 A	44.57 \pm 11.77 B
IL-4	112.32 \pm 23.33 A	29.22 \pm 1.57 B
IL-5	101.12 \pm 17.91 A	17.49 \pm 15.35 B
IL-10	89.11 \pm 11.42 A	35.25 \pm 5.32 B
IL-17	120.30 \pm 38.53 A	28.62 \pm 4.40 B

The results from table 1 indicate to height the levels of IgE, IFN- γ , IL-4, IL-5, IL-10, and IL-17 in patient group compared to healthy group, its reached (95.31 and 10.74) pg/ml respectively, for IgE, and (122.72 and 44.57) pg/ml respectively, for IFN- γ , while it reaches (112.32 and 29.22) pg/ml respectively, for IL-4, and also reaches (101.12 and 17.49) pg/ml respectively, for IL-5, as for IL-10, it reaches (89.11 and 35.25) pg/ml respectively, and it reaches (120.30 and 28.62) pg/ml respectively, for IL-17.

The different letters indicate to significant differences at the $p \leq 0.05$ (Horizontal comparative)

Helminthic infections provoke an immune response governed by Th2 cells, with eosinophils serving a vital function in the host's defense mechanisms. Intestinal parasites in the host organism result in increased concentrations of immunoglobulin E (IgE). Basophils, mast cells, and eosinophils generate pro-inflammatory mediators upon IgE binding to antigens on the surfaces of parasites, resulting in inflammatory responses. Thereafter, the activated Th2 cells can secrete interleukins, namely IL-4, IL-5, and IL-13. IL-5 stimulates increased eosinophil production, which adhere to the parasite while concurrently releasing major basic protein (MBP) and eosinophilic cationic protein (ECP). This technique adversely affects the parasite, resulting in its expulsion from the host organism (Maizels *et al.* 2004, Niedworok *et al.* 2008) [20, 23].

Dold and Holland (2010) [6] have shown that resistance to helminthic infection is typically linked to Th2 responses. However, the specific immunological pathways responsible for the removal of pinworm have not yet been determined. Several surveys have been conducted to study the specific patterns of antibody and cellular immune responses in the host population to antigens. These surveys are usually carried out before and after chemotherapy treatment. These studies typically establish a connection between immunological signaling or effector molecules and the severity of infection, and occasionally, the likelihood of being susceptible to it.

Preliminary field surveys investigated the correlation between the immune system's specific immunoglobulin responses in persons infected with some nematodes such as *A. lumbricoides* and the severity of the infection. The amplitude of the antibody response is believed to be influenced by various factors, including age, infection intensity, history of infection, and individual host genetics. From a biological standpoint, IFN- γ is a multifunctional cytokine with antiviral, anticancer, and immunoregulatory properties. It is therefore the basis for regulating the immune response, both innate and acquired immune responses (Mendoza *et al.*, 2019) [21].

Another study indicated that high levels of IFN- γ are ideally associated with the Th1 cell immune response against intracellular pathogens (Bourke *et al.*, 2011) [3].

A study conducted on *S. obovelata* worm showed that infection with this worm stimulates a Th2 immune response, which can be distinguished by elevated levels of interleukins (IL-4, IL-5 and IL-13), the latter of which are associated with allergic responses (Michels *et al.*, 2006) [22].

The current results are agreement with those of Al-Mohammed *et al.* (2024) [2], who showed a significant increase in IL-4 levels in individuals infected with *E. vermicularis* compared to healthy individuals.

Else *et al.* (1994) [8] pointed out that IL-4 plays a vital role in helminthic infection by inhibiting the activity of pro-inflammatory cytokines. However, IL-4 facilitates activation of B cells and differentiate to each IgE and IgA, thus increasing the immune response and causing worm expulsion.

Chang *et al.* (2019) [4] demonstrated elevated levels of IL-4 and IgE in patients infected with intestinal worms, including *E. vermicularis*, relative to healthy individuals.

IL-10 suppresses the secretion of pro-inflammatory cytokines, including TNF- α , mediators by monocytes and neutrophils (Lalvani *et al.* 1996; Kurtis *et al.* 1999) [19, 17]. Moreover, IL-10 plays a vital role in strengthening immunity and avoiding parasitic infections by controlling the intensity of both Th 1 and Th 2 immune responses. The study conducted by Gome-Escobar *et al.* (1998) [13] and Staderker (1999) [27] found that it has a substantial effect on decreasing immunopathology. Elevated concentrations of IL-10, IL-12, and TNF- α together are a standard physiological mechanism for maintaining immune homeostasis (Shmarina *et al.* 2001) [28].

In conclusion, the increased concentration of IL-5 and IL-10 suggests that these cytokines play a crucial role in the body's response to *E. vermicularis* infection (Goddey *et al.* 2010) [12].

3. Physiological variables

The current findings indicate, as illustrated in table 2, a significant increase in the concentrations of GOT, GPT, and ALP in the *E. vermicularis* patient group compared to healthy group, reaching 18.57 and 2.61 ng/ml for GOT, 0.177 and 0.064 ng/ml for GPT, and 34.15 and 8.23 ng/ml for ALP, consequently.

Table 2: The concentrations of physiological parameters under study

Groups and Parameters	Patient group	Healthy group
	Mean \pm SD (ng/ml)	
GOT	18.57 \pm 4.29 A	0.28 B \pm 2.61
GPT	0.177 \pm 0.07 A	0.02 B \pm 0.064
ALP	34.15 \pm 6.93 A	8.23 \pm 2.78 B

The different letters indicated to significant differences at the $p \leq 0.05$ (Horizontal comparative)

The present findings correspond with those of Rahimi *et al.* (2017) [26], which indicated an increase in liver enzyme levels in people infected with *E. vermicularis* relative to reference values.

Furnée *et al.* (2015) [10] discovered that colorectal liver metastases manifest in approximately 50% of individuals diagnosed with colorectal cancer. Up to 25% of these people display simultaneous liver metastases. The advanced CT scan is the primary imaging modality for assessing liver metastases. Histopathological examination of a liver resection in a patient diagnosed preoperatively via CT with synchronous solitary colorectal liver metastases ultimately revealed a benign lesion linked to *Enterobius vermicularis* infection of the liver.

Parasites are the causative agents of the most prevalent infectious disorders. The World Health Organization (WHO) indicates that nearly fifty percent of the global population is affected by parasites. Concerning their location, such infections may present various signs and symptoms, including intermittent abdominal pain, anorexia,

nausea, vomiting, diarrhea, anemia, eosinophilia, weight loss, jaundice, and intestinal obstruction; therefore, diagnosing parasitic infections and their sequelae can be intricate. Numerous studies indicate that the introduction of diseases and parasites into the body throughout different phases of evolution and migration correlates with alterations in serum protein fractions and cellular metabolism. Experimental investigations indicate that aminotransferase levels may fluctuate due to parasite infections. These enzymes catalyze the transfer of an amine group to an alpha-keto acid (Garba, and Gregory, 2006; Onyesom and Onyemakonor, 2011) [11, 24].

Glutamic-Pyruvic transaminase (GPT) is predominantly found in the liver. Glutamic oxaloacetate transaminase (GOT) is mostly localized in the heart, with supplementary concentrations in the liver and skeletal muscles. A potential cause for alterations in standard liver enzyme levels is the detrimental impact of parasitic infections on hepatic function, as certain parasites reside in the liver either permanently or transiently; their traversal through the body also induces cellular damage. The release of enzymes into the bloodstream transpires following an injury or cellular demise, with their concentration immediately correlating to the quantity of damaged cells and the duration between the injury and assessment. Consequently, assessing their levels is essential for clinical diagnosis, including liver and biliary duct disorders, cardiovascular illnesses, infections, inflammatory and allergic conditions, as well as determining blood donor eligibility prior to transfusion (Huncrantz *et al.*, 1986; Pohl *et al.*, 2001) [15, 25].

Wendt *et al.*, (2019) [30] indicated to extraintestinal infection with *E. vermicularis* patterns can be in the vagina, urinary bladder, peritoneum, kidneys, liver.

4. Conclusions

1. The levels of ALP, GPT, and GOT enzymes increase in Patient group contrasted healthy group.
2. There is a notable rise in the levels of both IgE and Cytokines as a consequence of the infection.

5. Contradictory interests

The authors declare that they have no conflicting interests.

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