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ORIGINAL ARTICLE

Seropositivity of Toxoplasma gondii in Children with Bronchial Asthma at Benha University Hospital, Egypt

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ABSTRACT

Background: Bronchial asthma is the most frequent chronic disease in children. Asthma exacerbation is a leading cause of pediatric morbidity and hospitalization, and children's social and emotional lives. Toxoplasma gondii (T. gondii) has been linked to a lower prevalence of allergy illness and has been regarded as a measure of poor hygiene. Microbe-induced Th1 cytokines such as gamma interferon have been postulated to mediate the protective impact of microbial exposure. The goal of the study was to investigate the imaginable association between T. gondii infection and asthma in children.

Methods: A comparative case-control study was conducted on patients at Benha University Hospital's Pediatric Department and Allergy & Asthma clinic from October 2016 to October 2017. This study included 105 children (35 with resistant bronchial asthma, 35 with responsive bronchial asthma, and 35 healthy control children). They were tested for anti-T. gondii IgG seropositivity using ELISA.

Results: Our results showed that only two patients (5.7%) of 35 were positive for Toxoplasma in the resistant asthmatic group. Still, four patients (11.4%) of 35 among the responsive asthma group were positive, while nine patients (25.7%) of 35 in the control group were positive for T.gondii IgG.

Conclusions: Our findings show a link between Toxoplasma infection and reduced allergy symptoms in the groups investigated. Infection with T.gondii may help prevent bronchial asthma from developing.

Keywords: Toxoplasma, children, bronchial asthma.

INTRODUCTION

Bronchial asthma is a pulmonary disorder characterized by extensive, reversible inflammation and constriction of the airways [1]. In both industrialized and developing countries, asthma is a severe public health issue. The World Health Organization estimates that 300 million people worldwide have asthma, with this number expected to rise to 400 million by 2025 if current trends continue [2]. Pathology changes seen in bronchial asthma include increased production of allergen-specific immunoglobulin E (IgE) serum levels, predominant eosinophilic airway inflammation, increased mucus secretion, and development of in vivo hyper-reactivity dependent on increased production of T helper type 2 (Th2) cytokines [3]. Severe asthma is divided into three classes, each with its own set of public health messages and challenges: 1) Severe asthma that has gone untreated. 2) Severe asthma that is difficult to manage. 3) Severe asthma that is resistant to treatment. The following are members of the last group: Asthma that does not respond to the highest level of recommended treatment and asthma that can only be controlled with the highest level of recommended treatment [4]. Because of its distinctive characteristics, T. gondii has been seen as a sign of poor hygiene and linked to a decreased prevalence of allergic disease: It's an obligate intracellular protozoan that's found throughout the planet. In the early phases of parasite infection, a robust T cell-mediated immune response is induced, characterized by highly Th-type1 polarised responses that persist during chronic infection [5]. Despite epidemiological evidence and recognized characteristics of the immune response associated with toxoplasmosis, the impact of T. gondii infection on allergy development has not been well investigated.

This study aimed to look into T. gondii

seropositivity in asthmatic children as well as the epidemiological parameters linked to the infection.

METHODS

A comparative case-control study was carried out on patients at Benha University Hospital's Pediatric Department and Allergy & Asthma Clinic from October 2016 to October 2017. A total of 105 children aged between one year to 15 years were enrolled, and for everyone complete history taking and full clinical examination was done (Table 1). Written informed consent was obtained from the parents of all participants and the purpose and the procedures were explained to them. The study was approved by the research ethics committee of the Faculty of Medicine, Benha University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Following a clinical evaluation of all cases, they were divided into three groups based on the results of the history and clinical manifestations: Group 1 (G1) included 35 children with resistant asthma who were either uncontrolled or treated with the most significant level of treatment available. Group 2 (G2) consists of 35 children with responsive asthma who respond to standard bronchial asthma treatment. Group 3 (G3) is a group of 35 healthy children age and sex-matched considered as the control group. All children had 2.5ml of blood drawn, centrifuged at 1,000 rpm, and sera kept at -20°C in the Parasitology Department of Benha University laboratory until stored samples were tested. The levels of anti-T. gondii IgG antibodies were measured using a commercially available quantitative ELISA kit, DRG® Toxoplasma IgG (TORCH) Catalog No. EIA-1798 (DRG International, Inc., Mountainside, New Jersey, USA). The test was carried out according to the manufacturer's instructions. In a nutshell, T. gondii antigen-coated microtiter wells received 100 l of each diluted serum sample (1:40). 100µl of 1:1,000 diluted horseradish peroxidase-conjugated anti-human IgG was added after 30 minutes of incubation. To halt the solution, tetramethylbenzidine (TMB) substrate was added to each well after a second incubation. An automated microplate reader was used to read the optical density (OD) values at 450 nm. The cut-off value for determining positive and negative sera was 1.040.

Statistical analysis

The data were tabulated and analyzed with the SPSS version 16 software (SpssInc, Chicago, ILL Company). Quantitative data were given as mean, standard deviation, median, and range, while categorical data was expressed as numbers and percentages. Categorical variables were analyzed using the Chi-square test (X^2) or Fisher's exact test (FET). Quantitative data were examined for normality using the Kolmogorov-Smirnov test, assuming normality at $P > 0.05$, and using the Student "t" and ANOVA (F) tests as a normal distribution. It was considered relevant if the P-value was less than 0.05.

RESULTS

Our findings revealed a significant difference between the children tested in family history and exposure to dogs or cats. 88.6% and 80% of responsive and resistant asthma patients respectively had a positive family history compared to 0% of controls. Also, 74.3% and 77.1% reported positive exposure to dogs or cats compared with 20% of the controls (Table 1). In all groups, there was no statistical difference in age, gender, or place of residence.

The prevalence of Toxoplasma among controls was significantly higher (25.7%) than in the responsive asthma group (11.4%) and resistant asthma group (5.7%) (Table 2).

Table 1: Characteristics of the sample studied in terms of socio-demographics.

Variable		Controls (n=35)		Responsive asthma (n=35)		Resistant asthma (n=35)		X^2/ Fisher's test/ ANOVA	P
		No.	%	No.	%	No.	%		
Age (ys)	**Mean ±SD**	7.8±3.4		7.3±3.5		8.9±3.1		**ANOVA (F test)= 2.02**	**0.14 (NS)**
	Range	2-15		2-15		3-16			
Sex	**Male**	18	51.4	17	48.6	19	54.3	**0.23**	**0.89 (NS)**
	Female	17	48.6	18	51.4	16	45.7		
Residence	**Rural**	15	42.9	22	62.9	24	68.6	**5.2**	**0.073 (NS)**
	Urban	20	57.1	13	37.1	11	31.4		
Family history	**Positive**	0	0.0	31	88.6	28	80.0	**67.8**	**<0.001 (S)**
	Negative	35	100	4	11.4	7	20.0		
Exposure to	**Yes**	7	20	26	74.3	27	77.1	**29.6**	**<0.001 (S)**

Variable		Controls (n=35)		Responsive asthma (n=35)		Resistant asthma (n=35)		X^2/ Fisher's test/ ANOVA	P
		No.	%	No.	%	No.	%		
dogs/cats	**No**	28	80	9	25.7	8	22.9		
NS= Non-significant								S= Significant	

Table 2: Prevalence of Toxoplasma gondii among the studied groups.

			Groups			Total
			Controls	Responsive asthma	Resistant asthma	
Toxoplasma		**NO**	9	4	2	15
IgG:	**Yes**	**%**	25.7%	11.4%	5.7%	14.3%
	No	**NO**	26	31	33	90
		%	74.3%	88.6%	94.3%	85.7%
Total		**NO**	35	35	35	105
		%	100.0%	100.0%	100.0%	100.0%
			X^2=6.07		P<0.05 (S)	

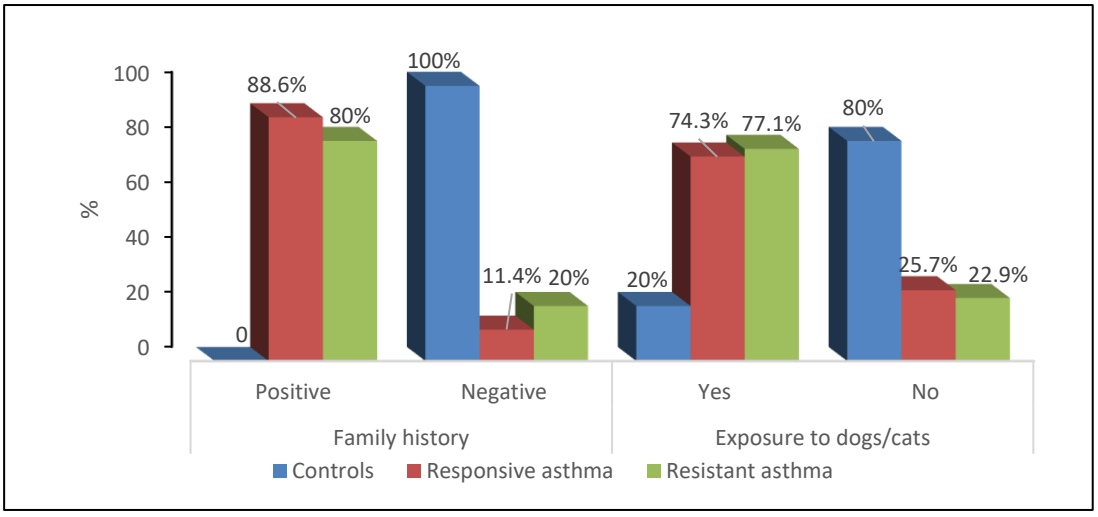

Figure 1: Bar chart showing the distribution of family history and exposure to dogs/cats among the studied groups.

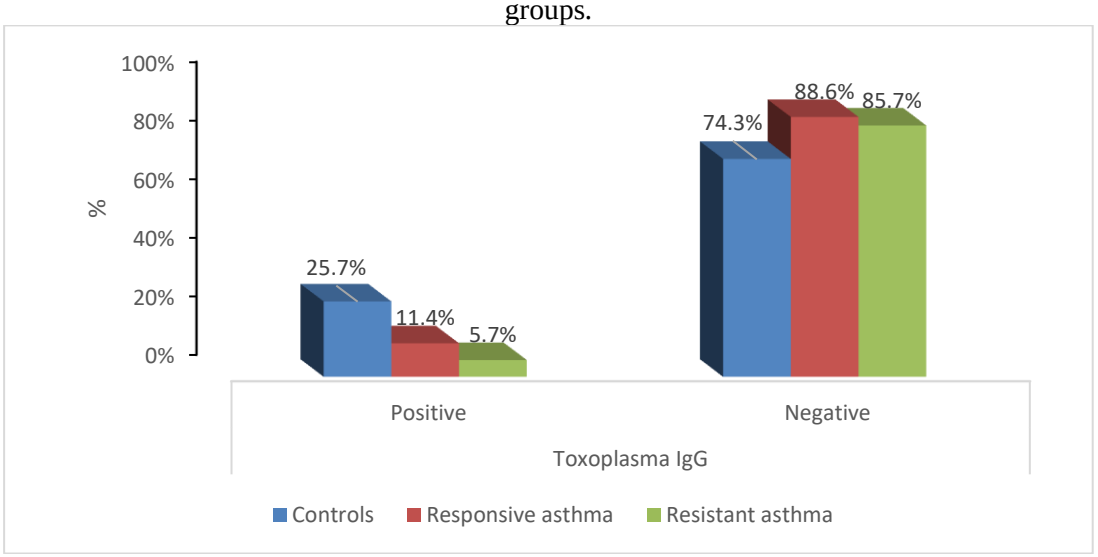

Figure 2: Bar chart showing the prevalence of Toxoplasma IgG among the studied groups.

DISCUSSION

The causes of the rise in allergy prevalence are still unknown. Asthma pathogenesis is influenced by various variables, including genetic predisposition, infections, and environmental exposure. These two last elements are undoubtedly the primary causes of the observed increase [6]. There was no statistically significant difference in age or gender between the groups tested in our study. The positive family history of atopy was significantly higher among asthmatic patients than in the control group, with 88.6% and 80% of responsive and resistant asthma patients having positive family histories, respectively, compared to 0% of controls (P= <0.001). This significant difference suggests that atopy is a risk factor for asthma, which agrees with Abdallah et al. [7], who found that a positive family history of allergy and the presence of other one or more allergic diseases were strongly associated with risk factors for asthma (p=0.000) and disagrees with Mai et al. [8]. They mentioned that there was no substantial increase in the family history of any atopy in asthmatic children (p=>0.05). In the present work, 74.3% of responsive asthma and 77.1% of resistant asthma reported positive exposure to dogs/cats compared with 20% of the controls. This is in line with Hassan and Hagrass [9], who discovered a link between asthma and the presence of family pets such as dogs and cats in the home. According to a study conducted by Ownby et al. [10], the protective effect of dogs and cats against allergic sensitization and asthma development is due to increased exposure to bacterial endotoxin associated with household pets rather than allergen exposure. Endotoxin exposure is thought to shift the developing immune system from a Th2-type response to a Th1-type response, favoring allergic sensitization. However, according to Korppi et al. [11], such exposure may increase the chance of allergic diseases. Regarding the prevalence of Toxoplasma infection among the studied groups, we found that Toxoplasma among controls was significantly higher (25.7%) than in responsive asthma (11.4%) and resistant asthma group (5.7%), P < 0.05.

This is consistent with the findings of Fernandes et al. [12], who looked at 275 people (129 atopics and 146 non-atopics) and discovered that non-atopics had significantly higher seropositivity to T. gondii (50%) than atopics (33%). According to Romagnani [13], Microbe-induced T-helper1 cytokines such as interferon-gamma could mediate the protective effect of microbial exposure. However, the immunological bases are disputed, and while changes in T-helper2/T-helper1(Th2/Th1) balance are likely important, they may not be the whole story. Intriguingly, epidemiological studies have found that people exposed to orofecal and food-borne microbes like T.gondii are less likely to develop respiratory allergies [14].

Our findings corroborated those of Linneberg et al. [15], Janson et al. [16], and Ellersten et al. [17], who found a lower prevalence of T. gondii infection in atopic patients compared to non-atopics, reinforcing the hypothesis that higher exposure to T. gondii reduces sensitization on a population level. Other studies, such as those conducted by Bodner et al. in 2000 [18], Radon et al. in 2004 [19], and Birgisdóttir et al. in 2006 [20], found no link between T. gondii seropositivity and atopy.

Also, according to Fenoy et al. [21], T. gondii infection prevents allergic airway inflammation, and the mechanisms are linked to the parasite's Th1 solid response and regulatory cell induction. Soto et al. [22] discovered that Tg PI-1, a T. gondii protein, has an inhibitory effect against serine proteases, which have a role in asthma etiology by enhancing inflammation and tissue remodeling.

CONCLUSION

Finally, our findings show that T.gondii infection may protect youngsters from developing bronchial asthma. More research is needed to determine the precise mechanism of protection.

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